



सत्यमेव जयते

GOVERNMENT OF INDIA
**MINISTRY OF
IRRIGATION & POWER**

**REPORT OF RIVER VALLEY
PROJECTS TECHNICAL
PERSONNEL COMMITTEE
NEW DELHI**

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1956

PRINTED IN INDIA BY THE MANAGER, GOVT. OF INDIA
PRESS, NASIK ROAD, 1957.

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REPORT OF THE RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE

CHAPTER I INTRODUCTORY

During the First Five-Year Plan the country has been spending on an average over Rs. 100 crores annually on irrigation and power projects. This is perhaps the largest single item of expenditure under the Plan. It far exceeds also the amounts spent on such projects not only in pre-independence days but also in the post-independence era before the commencement of the First Five-Year Plan. More than 100 schemes were under execution in different parts of the country at the end of the Plan period and the Second Five-Year Plan which has already begun envisages an even greater outlay on such schemes and it appears fairly certain that under the third and Fourth Five-Year Plans, the expenditure will be at least of the order of the average annual expenditure in the Second Five-Year Plan.

2. River Valley Projects again employ vast numbers of engineering personnel. It is obvious that their efficient and speedy execution will require a well-defined personnel policy. The experience of the First Five-Year Plan shows that on the one hand work is being held up on account of shortage of technical personnel in some parts of the country, and on the other hand in other parts of the country such personnel is surplus because of the completion of some projects or parts of projects. Apart from other considerations, such maladjustment of technical personnel involves loss of efficiency because persons who gain valuable experience on one project cannot put it to use on other projects where it is required. Inevitably time is lost in training new personnel in sufficient numbers and efficiency suffers in the process. Planned utilisation of technical personnel is therefore essential both in the interest of the personnel itself and of the projects.

3. With this object in view the Government of India in the Ministry of Irrigation and Power appointed the River Valley Projects Technical Personnel Committee under Resolution No. 24(14)/54-Adm., dated 10th July 1954. The original composition of the Committee was as follows :—

1. Shri W. X. Mascarenhas, I.S.E.,
Chief Engineer,
National Defence Academy Project,
Poona Chairman.
2. Shri B. N. Datar,
Planning Commission Member.
3. Shri G. K. Chandiramani,
Ministry of Education,
Government of India Member
4. Shri Ripudaman Singh, I.S.E.,
Central Water and Power Commission,
New Delhi Member-Secretary.

The Committee was given powers to co-opt.

4. At the first meeting of the Committee held on July 22, 1954, the following gentlemen were co-opted as members :—

1. Shri N. S. Gupchup,
Special Engineer (Planning),
National Defence Academy Project,
Poona Member.
2. Lt. Col. J. V. P. Braganza,
T.D.E. (Vehicles),
Ahmednagar Member.
3. Shri R. S. Basrur,
Mechanical Cultivation Engineer
Government of Bombay,
Poona Member.

Subsequently, Shri A. K. Char, Chief Engineer, Chambal Project, was appointed a member of the Committee with effect from 18-2-1955 under Government Notification No. 24(14)/54-Adm. I., dated 18th February 1955.

5. The Committee was asked to visit the River Valley Projects under construction in the country and after studying the various factors affecting the requirements of technical personnel, to make recommendations on the following:—

- (i) The strength of technical and accounts personnel of various categories required for the planning and execution of River Valley Projects and Flood Control Schemes, proposed to be undertaken in the country during the next 15 years, including those already under execution and of the operational personnel required after their completion.
- (ii) The steps that must be taken in order that the theoretical and practical talent necessary to meet the requirements under (i) above is forthcoming in this country and specially that the higher planning staff, capable in due course of assuming positions of the highest trust and responsibility, is progressively trained for the purpose.
- (iii) The means of securing the co-operation of universities and professional institutions and service organizations, e.g., the Corps of Army Engineers, in the training of personnel for the Projects.
- (iv) The extent to which the assistance of foreign experts and technicians will be necessary and the agencies through whom such assistance should be secured.
- (v) The procedure to be followed in securing liaison and co-ordination between the various States *inter se* and between the States and the Central Government in the employment of available personnel in the best interests of the country.
- (vi) Ways and means of improving efficiency and raising the morale of the engineering services of the Central and State Governments, with special reference to the Irrigation and Power Cadres.

6. The Committee was requested subsequently to include within the scope of its inquiry the question of facilities already existing for the training of personnel for handling various types of machinery and plant on the River Valley Projects.

7. As desired by the Minister for Irrigation and Power, the Committee submitted a special Interim Report on May 2, 1955. The Report was confined to a brief exposition of the substance of the Committee's findings in respect of items (i), (ii), (iv) and (v) of the terms of reference. The chief recommendations were in respect of expansion of training facilities necessary to enable the State Governments to meet the requirements of the Second and subsequent Five-Year Plans and only the broad outlines of the reasoning underlining the Committee's findings were given. Our Interim Report also noted that it was necessary for the comprehensive planning of training facilities to take an overall view of requirements not only for River Valley Projects, but also for all other spheres of developmental activity. The Engineering Personnel Committee was appointed by the Planning Commission in September 1955 to make this overall assessment and we are glad to find from the Committee's Report that our approach to the problem and general basis of assessment of personnel have been accepted by the Committee.

8. The Committee split itself into a number of Sub-Committees, consisting of Members who were specially familiar with the problems to be dealt with. These Sub-Committees were (i) Civil, Mechanical and Electrical Works Sub-Committee; (ii) Recruitment, Training and Organisation of Personnel Sub-Committee; (iii) Assistance of Foreign Experts Sub-Committee, (iv) Liaison Sub-Committee; and (v) the Methodology Sub-Committee. The Committee also issued questionnaires to the various States, Corporations, Control Boards, Project Authorities and selected Engineers; special questionnaires were also addressed to the Principals of Engineering Colleges and Technical Institutions. Suggestions were also invited for improving the quality of the training given to engineers, especially in the designing, planning and execution of River Valley Projects. Proformae for assessing the requirements of accounts personnel were sent to Accountants-General and Controllers of Accounts of various Projects. The proformae are printed in Appendix I. Most of the information analysed for the purpose of this Report was collected by the engineering staff attached to the Committee through personal contacts with the various State and Project Authorities concerned. Members of the Committee also themselves visited some important project sites, and had useful discussions with the Deputy Chairman of the Planning Commission, the Minister of Irrigation and Power at the Centre, Ministers in different States and Officers of the Central and State Governments.

9. The Committee would like to take this opportunity to record its appreciation of the energy and enthusiasm with which the technical members of its office staff discharged their duties, and in particular of the valuable contributions made by Sarvashri Krishna and Achhar Singh Nagpal, Assistant Executive Engineers and M. M. Vaswani, Assistant Engineer.

CHAPTER II

RETROSPECT AND PROSPECT

10. In the midst of the tremendous development programme under execution all over the country at present, it is difficult for any except the most senior engineers to recall a time when works of any magnitude were so few and far between that to all intents and purposes the quarter of a century before independence may be described as a "barren" period, from the point of view of engineering construction, *vide* Appendices II and III. The effect of the two World Wars on engineering practice and personnel was generally anything but salutary. During World War II almost anybody with pretensions to technical knowledge was readily recruited in the lower engineer cadres, and even the officer cadres, particularly of the M. E. S., Railways, etc., and almost any kind of work found acceptance. After independence the need for self-sufficiency in food and the national policy of building up a Welfare State led naturally and inevitably to the undertaking of a stupendous country-wide construction programme, the impact of which on the engineer cadres in the country, reared in the "barren" period since 1922 and further demoralised by the Second World War, was well-nigh disastrous. The hurry with which many of the Projects were undertaken and the emergence of new techniques of construction greatly aggravated the situation and led to the present crisis in engineering circles in the country. This crisis may briefly be described as a crisis of lack of self-confidence in those circles. Foreign consultants have been freely engaged, and foreign executives and technicians are even employed on actual construction in the country. In the circumstances described, this reliance on foreign experts is understandable, but cannot obviously be indefinitely perpetuated in its present form.

11. A note of caution needs to be sounded here. There would appear to be an urge on the part of some State Governments and even of many engineers to do something spectacular and plan works which are beyond their own capacity or the country's real needs. This needs to be resisted, specially where the location of the projects or their physical dimensions are such as make for complicated planning and intricate construction. The country's demands could, we believe, be more conveniently and economically met in a vast majority of the cases by a large number of medium-sized projects than a small number of gigantic size.

12. The problem of estimating the requirements of technical personnel for river-valley projects must be considered against this background, and the measures proposed to meet these requirements must obviously not only aim at producing the required numbers of trained personnel of various categories, but also, and indeed chiefly, at raising their efficiency and restoring their self-confidence by giving them the necessary practical experience.

13. It is scarcely necessary to emphasise that the requirements of engineering personnel for river-valley projects cannot be isolated from the requirements for other construction projects. We need engineering personnel not only for river-valley projects, but also for extending and improving road communications, developing railways, setting up factories, building schools, hospitals, offices and so on. The demands that the river-valley projects will make on engineering personnel have therefore to be such as

will enable all these other activities in the public and private sectors of the national economy to be maintained at the pace aimed at in the successive Five-Year Plans. Though river-valley projects differ from other projects in that there is a natural limit to the development of our water and power resources, and at some time construction activity connected therewith will taper off, such a time is so far distant as should make no difference in our present assessment.

14. An important consideration in the assessment of technical personnel for river-valley projects is their mode of execution or the relative emphasis placed on the use of manual labour as against equipment, which in this context are sharply conflicting elements. There is on the one hand a desire to provide large scale employment through construction in the series of plans to come—for which constructional activity of the future will have to be labour-intensive; on the other hand the large-scale use of machinery is advocated to quicken the tempo of development and to provide the benefits resulting from the early completion of projects. There are considerations peculiar to the development of certain water resources which may make one mode of construction preferable to the other. No clear indication of the future mode of construction being at present discernible, we have assumed that the present pattern of relationship of men and machinery will be maintained during the next 15 years. In making our assessment therefore we are aware that not only the number of technical personnel required but also their skills will differ, if this pattern is substantially altered in future.

15. The requirements will again vary according to the agency of construction, viz., departmental or contractual. It is our view that in terms of personnel engaged the latter agency is the more economical, but dependable contractors capable of handling large river-valley projects competently are so few and far between that we have assumed that both agencies will continue to function as at present and in roughly the same proportions. Our assessment relates only to departmental technical personnel. In computing the demand we have examined the procedure adopted by the Scientific Man-Power Committee to assess the requirements of scientific personnel required for the creation and expansion of industries and other developmental activities as envisaged in 1948, which was to study on a sample basis the scientific personnel employed in selected units in different fields, and establish what it termed the "production-to-personnel" ratio for each such field. Applying to this ratio the correction factors appropriate to the different types of production, the Committee made its assessment of total scientific personnel requirements. As to engineering personnel, which was also included in the scope of the Committee's enquiry, the method adopted by the Committee allowed for factors like (a) the varying types of constructional works handled, (b) the different engineering practices followed, and (c) the type and number of technical personnel required for certain unit sizes of operation.

16. The experience gained in some foreign countries, especially the United Kingdom and the United States of America, in the assessment of scientific and technical personnel requirements has certain valuable lessons for us. It has been recognised in these countries that since the growth of scientific and professional groups has been irregular, the projection into the future of past trends in respect of demand would provide only a very uncertain guide. Further, no formal calculation can ever provide for all possible changes in the factors which would affect the future demand for any group or category of personnel.

17. In the case of engineers, the procedure followed by the National Man-Power Council in the United States for estimating short-term requirements was to ascertain from representative industries and Government Departments, who together accounted for the employment of a known proportion of the total strength of engineers in the country, what their needs were in this respect. The leading questions asked of these authorities were designed to elicit information as to the number of persons they wished to absorb each year at the existing salary levels. On the basis of these requirements and the proportion they bore to the volume of total engineering employment in the country, a rough measure of the overall demands was arrived at.

18. Two important aspects which should also be kept in mind in all assessment of personnel are: (a) simple *quantitative* estimates of supply and demand can sometimes be misleading, since they take no account of the *qualitative* changes in the personnel to be recruited, and (b) calculation of the total numbers of personnel available leaves regional maldistribution out of account.

19. In the United Kingdom, the Barlow Committee on Scientific Man-Power was appointed in 1945 to consider policies which should govern the use and development of scientific man-power resources during the ten years following. The Committee reported on very broad lines in 1946 and said—"to establish a reliable quantitative assessment of demand and supply for each scientific subject would involve a formidable statistical enquiry, which if attempted would have seriously delayed the presentation of the Report". In view of the magnitude of the problem therefore the Ministry of Labour and National Service appointed the Technical Personnel Committee under the chairmanship of Lord Hankey. The method of working adopted by the Hankey Committee was to form sub-committees for different fields and each of these sub-committees in its turn appointed panels and in some cases sub-panels.

20. In the Reports of the Hankey Committee (there are separate reports for different fields of specialisation like physics, metallurgy, chemical engineering and so on) it has been emphasised that in planning over a period of time particular attention has to be paid to occupations which require relatively long training, and since the elimination of shortages is the main objective of any such enquiry, the location of shortages and remedies for meeting them have also to be suggested. The Reports have recognised that while the supply of technical personnel can always be ascertained from the records of universities and other examining bodies and rosters of professional institutions, census data and so on, the estimation of demand invariably takes one into more debatable territory. In the United Kingdom as well as in the United States, the attempt to compile demand statistics is made by issuing questionnaires to Government Departments, industries, manufacturing and professional groups of nation-wide importance, and educational institutions, because they come into the picture not only with regard to supply but also to their own demand for additional teachers.

21. In the U. K. and U. S. A. it was left to individuals to draw up their plans for the utilisation of man-power. In view of the overall shortages such individual planning had to be made well in advance and had moreover often to provide for supernumeraries in the present to avoid disappointment at a later stage. It is extremely doubtful whether in this country the private sector will provide for its future man-power requirements in this manner.

In the case of technical personnel for river-valley projects, there is at least some broad indication of what we expect to achieve in the next 15 years. Again since nearly all the work on these projects is done under Government auspices, we may reasonably expect some uniformity in the supply of data on the basis of which the demands may be predicted.

22. The problem of finding personnel at the lower levels is simplified in the United States because of the tendency in that country to break down a job into its components, thus making it possible to utilise a number of persons with limited skills. At the same time the man-power pool from which persons who take these jobs come is gradually becoming more and more qualified because of the standard of general education going up. In the United Kingdom, though a job is not broken down to anything like the same extent as in the United States, owing to this improvement in the general educational standard, a higher degree of skill is brought to bear on a job than used to be the case previously.

23. In this country the breaking down of a job into its components and training of personnel for limited skills has been undertaken in a big and organised way only recently. The general educational standard has improved but not to the same extent as in the U.S.A. or U.K. The problem of finding personnel, even at lower levels, is therefore still difficult. One encouraging indication that things are changing, even if slowly, is that provided, for example, by the Gangapur Dam Project on which the breaking down of jobs was effected and men successfully trained to acquire limited skills in a short time.

24. In the case of a well-established industry, it is easy to correlate technical personnel requirements with the volume of production; but it is well-nigh impossible in the case of River Valley Projects to correlate the personnel to any fixed development targets, such as area irrigated or power generated, since the physical dimensions of the engineering works involved vary widely from project to project with the same targets. We have therefore had perforce to adopt an approach which is commonly referred to in man-power studies as the "expenditure-to-personnel" ratio approach.

CHAPTER III

ASSESSMENT OF DEMAND

25. The term "technical personnel" has a very wide connotation. It covers the whole technical hierarchy from the Chief Engineer or General Manager, who directs and controls all investigations, planning and execution of a project, at one end of the scale, to a mason or stone-dresser at the other. Again there are ancillary personnel possessing special technical or quasi-technical skills, such as geologists, chemists, accountants, administrative personnel, welfare officers, etc., who must also be taken into account. Viewed in its full dimensions the Committee's problem of assessing the technical personnel requirements of the river-valley projects assumes such formidable proportions and exhibits so many ramifications that in order not unduly to prolong our inquiry we have had to limit it to certain broad categories, in which critical shortages are even now experienced and of which the training has to be planned well in advance to meet future needs. The categories specially chosen are—

(a) *Graduate Engineers:*

This category includes personnel possessing engineering degrees, including post-graduate qualifications, and covers the whole field of higher engineering talent in the civil, mechanical and electrical branches from Assistant or Deputy Engineers upto and including Chief Engineers.

(b) *Overseers and Draughtsmen:*

This category includes supervisory personnel, commonly referred to as overseers, possessing degree or diploma qualifications; also draughtsmen, who are normally recruited from among diploma-holders and sometimes even engineering graduates.

(c) *Sub-Overseers or Maistries:*

Who do not possess any recognised technical qualifications, but are capable of exercising supervisory functions of a restricted character on works, by virtue of their long apprenticeship on engineering construction and practical experience.

(d) *Mechanical Assistants:*

Which term covers all personnel concerned with the operation, maintenance and repair of machinery, including earth-moving machinery, crushing plant, rope-ways, cable-ways etc., and includes foremen, chargemen, etc, but excludes artificers, such as turners, fitters, blacksmiths, etc.

(e) *Electrical Assistants:*

This category represents in the electrical field what category (d) above does in the mechanical field.

(f) *Accountants:*

This category includes Divisional Accountants and all those exclusively connected with accounts, but excludes Accounts Clerks.

26. On the construction side we have not considered skilled workmen, artificers and the like, because no serious shortages have been reported to us. We understand that the States, assisted by the Ministry of Labour, are providing adequate facilities for personnel at this level.

27. The mobility of all the above categories save (a), is generally speaking limited because the pays or wage-scales of the men make it extremely difficult for them to move from one linguistic region to another on account of the difficulties of educating their children, or in the alternative of maintaining two households, specially when the employment they are offered is temporary and of short duration. A certain number of men of course do move about, but in our view they constitute a small percentage of the total numbers employed. Again each State usually employs only men possessing its own domicile, and might even prefer to train up local men rather than employ men from other States, specially as such training does not need to extend over a long period, as experience on the Gangapur and Vaitarna Projects has so strikingly demonstrated. To some extent, this is a good thing. Local enthusiasm is harnessed in the service of the project and local conditions being better known to local men, working conditions become easier or at any rate less disagreeable, and efficiency consequently greater. Finally, the newly acquired skills are retained in the locality, not necessarily to be employed on the kind of work that the project afforded but in allied fields, e.g., locally developed large- and small-scale industries. If the history of the Tennessee Valley development repeats itself, even in a minor key, in our valleys, even agricultural practices will follow an improved pattern owing to the impact of the projects on the local populations, who are employed on their execution and continue to reside in the locality after their completion.

28. As regards ancillary personnel, Accountants are reported to be in short supply and require moreover a fairly long period of training. A part of the higher administrative staff of projects is included in category (a), viz., Graduate Engineers; the remaining part, and, we hope, a continuously diminishing one, will come from the existing-administrative cadres. As to other administrative staff, the requirements will be mostly of clerks of whom there is never likely to be any shortage; the only training needed for such personnel is that provided by a short period of attachment to existing offices and possibly short departmental courses in "accounts and procedure". The scientific personnel required for river-valley projects, such as geologists, physicists, chemists, etc., is so small in relation to our requirements of this class of personnel for the large-scale developmental programmes now being planned in other fields that we have omitted them from our purview altogether. Our attention therefore has been almost exclusively devoted to engineering personnel.

29. The nature of the demand for construction personnel is another important factor in its overall assessment. Technical employment on river-valley projects has a two-fold character. The first is of the nature of what is now being termed "revolving" employment, so called because once the construction stage of a project is completed, those engaged on it can continue to be given employment only if a new project of a similar type is undertaken. The second is of the nature of "sustaining" employment resulting from the project; this again can assume two forms, viz., (i) that provided to the maintenance crew required after the completion of the project; and (ii) that resulting from the extra technical skills required to be put in by the beneficiaries of the project. In the case of the river-valley projects part of the "sustaining" employment generated will absorb some of the skills which went to form the "revolving" component, but the remaining part will in large measure require skills which are outside the scope of our enquiry.

30. Seventeen typical projects at present being executed or recently completed have been analysed in some detail and the technical personnel of various categories employed thereon have been ascertained from the project authorities. The projects, together with their cost and category, are given in Appendix IV. These have then been related to the scope and cost of the project, and a yardstick derived wherewith it is possible to estimate the requirements of technical personnel for future projects of comparable scope and cost. It is evident that this yardstick can have only a limited utility in view of the considerations advanced earlier. It may also be noted that the projects chosen are not necessarily truly typical in the statistical sense. Nevertheless for an overall assessment of the kind we are attempting, we believe any other approach could not yield results substantially different from our own. The yardsticks derived are given in Appendices V & VI.

31. In adopting the above approach we have made certain assumptions which are only partially correct. One is that at the time that the analysis of each project was made, the personnel employed was fully up to requirements; actually, of course most of the projects were short-handed, particularly in respect of the lower categories. But in view of the fact that the shortages must have affected—though not proportionately—the rate of expenditure in any year, we believe that with our “expenditure-to-personnel” ratio approach they could be safely ignored. The second assumption is that the employment pattern will remain substantially the same in future projects; whereas it would not be unreasonable to expect that, with growing experience and profiting from the mistakes of the past, the project authorities would be able substantially to modify the pattern in the direction of economy and efficiency. A third assumption is that the price structure will remain unaltered over the next fifteen years—an assumption of doubtful validity; in this respect however we have an important precedent to go by, which is that in all long-range planning some constancy of prices is assumed for the sake of convenience; in any case the adjustments required for working out afresh figures of personnel requirements conforming to changes in price levels should not present serious difficulty, if suitable cost indices are used as correction factors.

32. We have examined the Bhakra Nangal Project, which is in a class by itself, and 16 other projects which are classified under six groups as follows :—

I. *Multi-Purpose Projects:*

(i) Projects costing under Rs. 10 crores.	.	.	.	Nil.
(ii) Projects costing over Rs. 10 crores	.	.	.	4

II. *Power Projects:*

(i) Projects costing under Rs. 10 crores	.	.	.	2
(ii) Projects costing over Rs. 10 crores	.	.	.	2

III. *Irrigation Projects:*

(i) Projects costing under Rs. 10 crores.	.	.	.	6
(ii) Projects costing over Rs. 10 crores	.	.	.	2

Total	.			<u>16</u>
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The projects which have been tentatively included in the Second Five-Year Plan have been put into their respective classes and the appropriate yardsticks used to determine their personnel requirements. As regards the total expenditure in the Second Five-Year Plan on irrigation and power projects, we notice that a provision of Rs. 913 crores has been made on this score. The corresponding figures for the Third and Fourth Five-Year Plans, to which our assessment also extends, have been assumed to be of the order of Rs. 1300 crores and Rs. 1650 crores respectively. The expenditure on irrigation and power projects has been mounting rapidly in the past few years, but such expenditure must sooner or later reach saturation point. The requirements of technical personnel of the "revolving" type will then become stabilised and additional personnel will be required only to man maintenance and operation crews and provide for normal wastage and the varying degrees of immobility applicable to different categories of personnel.

33. As a starting point for our computations, we took a census of the technical personnel actually engaged on the construction of all projects in hand in the country as on 1-4-54 and the figures so obtained were related to the level of expenditure during 1953-54. We then estimated the probable levels of expenditure in the following years for different groups of projects, and by applying the yardstick appropriate to each group arrived at the personnel requirement figures for those years. We also took a census of the maintenance and operation staff engaged on old and newly completed projects on the same date. (These census figures for staff engaged on construction and on maintenance are given in Statements I and II of Appendix VII.) This maintenance and operation staff will naturally show a progressive increase in future as the projects now under construction are completed. The requirements of technical and accounts personnel for planning, execution and maintenance of River Valley Projects proposed to be undertaken in the country during the next 15 years, including those already under construction, are given in Appendix VIII, Statements I & II.

34. One important premise on which we proceeded is that in the deployment of technical personnel the national interests will always prevail against the interests of any State and persons employed on river-valley development will have sufficient mobility, a premise of doubtful validity as we have explained at some length in a later paragraph.

35. When the requirements of personnel are worked out in the manner described above, it is found that (i) there is a big jump from the numbers (of all categories) existing on 1-4-54 to those required in 1956-57; and (ii) after 1956-57 the increase in requirements is comparatively modest.

36. The Report of the Engineering Personnel Committee discloses that most Government Departments had indicated comparatively heavy demands in the initial years of the Second Five-Year Plan. While conceding that in the case of certain priority projects like those sponsored by the Ministry of Iron and Steel, a considerable concentration of personnel demand in the initial years is unavoidable, the Engineering Personnel Committee feels that insistence by every Department on having the bulk of its personnel demands satisfied in the initial years of the Second Plan is unrealistic. It takes about four years after the Inter-Science to turn out an engineering graduate, and about three years after matriculation to produce a diploma-holder. As the supply of graduates and diploma-holders cannot be increased at short

notice, it is not possible to recruit the desired number of personnel in 1956-57 and the existing cadres will have to carry a heavy work-load for some time longer. The high demand in 1956-57 constitutes a "hump" which cannot obviously be crossed through the normal methods of training; special short-term measures must therefore also be resorted to. Our proposals in respect of the different categories enumerated in paragraph 25 above are detailed below—

(a) *Graduate Engineers:*

37. As will be seen from column 8 (c) of Statement No. I Appendix No. VIII the demand for 1956-57 is 1509 civil, 161 mechanical and 247 electrical graduate engineers as against an expected out-turn from the colleges in 1956 of 1,371,759 and 791* in the respective groups.

38. Column 14 of the same Statement shows that the average annual additional requirements of graduate engineers during the Second Plan after 1956-57, if the existing deficiencies are met during 1956-57, are only 194 civil, 34 mechanical and 90 electrical. In relation to the existing (1956) output, the replacement rate works out to 15% for civil engineers, 5% for mechanical engineers and about 12% for electrical engineers.

39. An analysis of the demand and supply position made by the Engineering Personnel Committee for the country as a whole reveals that the demand is greater than the supply and very high in the initial years of the Second Plan. The above demands therefore cannot be met in full by normal methods as we have already noted.

40. Incidentally many graduates are today wasted in positions below their training and skill and it is obviously in the country's interest to stop or at least reduce this wastage. We shall refer to this point again later.

41. So far as river-valley projects are concerned, our effort in the immediate future should be directed to crossing the "hump" which is expected to develop in 1956-57. It will thus be seen from Statement I of Appendix VIII (sum of columns 6a, 7a and 8a) that between the date of our census, viz. 1-4-54 and the commencement of 1956-57, an additional 2526 graduate engineers will be required for recruitment to the officer cadre; this large number must be chiefly drawn from among graduate engineers now in the Overseer cadres, if they have to have some previous experience, their places being taken by fresh graduates.

42. There would still be some shortages in the different categories of engineering personnel for the next three to four years and we concur in the recommendations of the Engineering Personnel Committee, most of which we had already made in our Interim Report, that there should be :

- (i) a judicious promotion from lower ranks;
- (ii) a more balanced utilisation of available talent;
- (iii) retention of persons for suitable periods beyond the age of superannuation;
- (iv) temporary overloading of the existing staff where this is not already being practised; and

*Obtained from Table XXIII of the Engineering Personnel Committee's Report.

(v) organisation of functional training at supervisory levels.

In order that all such short-term measures should not become a permanent feature of the general pattern of employment, we would strongly urge that the new institutions suggested by the Engineering Personnel Committee should be set up without delay.

43. The figures to which the out-turn of engineering graduates and diploma-holders in this country should be raised have been indicated by the Engineering Personnel Committee and are of course inclusive of the requirements of river-valley projects in these categories.

(b) *Overseers and Draughtsmen:*

44. The posts of Overseers are held at present by graduates, diploma-holders and a small number of unqualified men, who by long experience and outstanding ability have risen to the position of Overseer from among the ranks of workmen. It is in our opinion undesirable and wasteful for graduates to hold Overseers' posts, except possibly in a very few cases and for a brief period at the commencement of their careers. Diploma-holders are primarily intended for these posts, but it is questionable whether the kind of training they receive is always or everywhere best suited for the purpose.

45. The Engineering Personnel Committee has recommended that the output of civil diploma-holders should be brought to about 6,400 and that of electrical and mechanical diploma-holders to about 5,600 per annum.

46. This should be done with due regard to regional requirements, and the undesirability of overloading existing institutions by merely increasing the number of admissions should always be borne in mind; new institutions would be better than old institutions that are loaded beyond their capacity.

47. We wish to alter permanently the present heterogeneous and unsatisfactory pattern of employment in the overseer category by excluding graduates, except in a few cases and for short periods as already explained.

48. Draughtsmen are recruited from the same class as Overseers and accordingly have been lumped with them in our assessment.

49. To meet our immediate high demand for Overseers the chief short-term measure envisaged by us is the institution of an altogether new class or category of technical personnel, designated generically by the term "Technical Assistant" for the sake of convenience. These men will receive a limited training, which will nevertheless be quite adequate for their special but restricted function. Thus Technical Assistant (Survey) will be concerned solely with the ordinary type of survey work required for river-valley projects, like chain-and-compass surveying, levelling, simple theodolite traverse, etc. Technical Assistants (Concrete) will deal with the simpler aspects of concrete technology, i.e., mixing, cooling, placing, curing, shuttering, etc. These men, we suggest, should be recruited from among matriculates and given an intensive theoretical training for about 6 to 9 months to be followed by practical training on works, after recruitment, for another three months, at the end of which period they will receive their certificates. The different sub-categories of Technical Assistants required and the number under each sub-category should be left to the project authorities to determine.

50. We consider that the "hump" in the case of Overseers should be levelled off in two years' time. As it would take about 9 months to turn out a Technical Assistant (Civil) and somewhat longer for a Technical Assistant (Electrical and Mechanical), the first batch of Technical Assistants would be available in 1957-58. It would be necessary to turn out about 2200 Technical Assistants (Civil) and 550 Technical Assistants (Electrical and Mechanical) per year for the two years 1957-58 and 1958-59, after which a diminished programme of training would have to be continued.

51. The new category of Technical Assistants suggested above may be continued on a permanent basis in partial replacement of diploma-holders occupying the posts of Overseers, if the experience justifies it. Actually as the Engineering Personnel Committee has recommended that job-analysis should be carried out on all construction projects, this new category of functional assistants is likely to become a permanent feature.

52. The Technical Assistant category called expressly into being to see us through 1957-58 and 1958-59 will continue of necessity till at least 1960-61 as the greater part of the extra output of regular diploma-holders which will be created as a result of the implementation of the recommendations of the Engineering Personnel Committee will be available only from 1961 onwards. But even after the additional output of diploma-holders becomes operative, the Technical Assistants already recruited should in any case be continued indefinitely, subject to their work and conduct being satisfactory, as a mere 3 years' tenure of service, followed by retrenchment, will not serve to attract the right type of men or induce those that join to give of their best; it is only if they feel they are being given the opportunity of joining the profession permanently that we will get types who will put their heart into their work.

53. In fact, as we have already suggested, the category could be continued permanently with considerable economy to the national exchequer, if the results justified it. We need not, we feel, be unduly apprehensive about the effect on diploma-holders' employment of the measure referred to above, viz. continuing the first batch of trainees indefinitely and training new batches to provide a permanent cadre, if justified. With a continuously expanding economy, we can foresee almost limitless opportunities for the employment of 12,000 (6,400 civil and 5,600 mechanical and electrical) diploma-holders turned out every year; actually by normal standards we should have 4 diploma-holders for every graduate turned out, which means an annual output of 22,800 diploma-holders as against 5,700 graduates.

54. Again, with the virtual elimination of graduates from the overseer cadre there will be more vacancies to be filled by diploma-holders and Technical Assistants.

55. We recommend that Technical Assistants should be trained as indicated in the programme given below:

Technical Assistants (Civil)	Number to be trained per year
Period	
1957-58 to 1958-59.	2,200
1959-60 to 1960-61.	400
1961-62 to 1965-66.	Our rough estimate is that about 400 per year would have to be trained during the Third Plan period.

Technical Assistants (Mechanical and Electrical)	Number to be trained per year
Period	
1957-58 to 1958-59	550
1959-60 to 1960-61	240 or say 250
1961-62 to 1965-66	Our rough estimate is that about 250 per year would have to be trained during the Third Plan period.

NOTE 1.—It is impossible at this stage to make even a rough estimate of the requirements of Technical Assistants during the Fourth Plan period.

NOTE 2.—Training Classes should, we suggest, be organised by the Engineering Departments concerned, preferably at the sites of works. But it may be necessary to invoke the assistance of educational institutions for some part of the training, specially as far as the use of drawing-halls and other accommodation is concerned. If facilities do not exist at the sites of works, the whole of the theoretical training may have to be imparted in existing educational institutions or in the new ones proposed to be set up.

(c) *Sub-Overseers and Maistries:*

56. This is a category of men who do not possess any recognised technical qualifications. They are generally unlettered workmen, who have taught themselves the three R's and worked their way up to a position roughly approximating to that of a Technical Assistant described above. No special training facilities can be provided for this class; moreover the number needing to be recruited by 1956-57 is exceedingly small. It is possible that with the institution of the new category of Technical Assistants who will be recruited from among matriculates and receive some formal technical training, the Maistry and Sub-Overseer's class will disappear altogether.

(d) and (e) *Mechanical and Electrical Assistants:*

57. As regards Mechanical and Electrical Assistants, owing to their extremely limited mobility, the facilities provided for training the required numbers must be very wide-spread and as far as possible Training Centres should be set up at Project Headquarters or more suitable places near the sites of works.

58. Our estimate is that some 1,888 or, say, 1900 Mechanical Assistants and some 499 or, say, 500 Electrical Assistants will have to be recruited by the beginning of 1956-57, *vide* Statement No. 1, Appendix VIII [Column 8 (c).]

59. In view of the large numbers involved, it may not be possible to arrange formal training for all due to paucity of funds, but it will be necessary to have more centres like those already established by the Ministry of Irrigation and Power at Bhakra Nangal, Hirakud, Kotah and Tungabhadra.

60. The numbers to be turned out through regular centres may be determined by the States themselves according to their own circumstances.

61. It should also be possible to train a certain number of operators for various types of machinery by making arrangements for the purpose with the suppliers of such machinery.

(f) *Accountants:*

62. Arrangements will have to be made to see that the output available for the River-Valley Projects, is about 125 per annum from 1957-58 to 1960-61 and about 200 per annum during the Third Plan period. Such arrangements should be left to the States.



CHAPTER IV

OFFICER PERSONNEL AND THEIR RECRUITMENT

63. The Officer cadres of the Engineering Services are normally recruited from among engineering graduates, who have received their training in this country or abroad, by far the greater number being degree-holders of our own Universities. Any scheme therefore which aims at improving the calibre and efficiency of Officer personnel must begin with the engineering colleges in the country. In this matter however the Central and State Governments can play only a limited part in view of the fact that almost all engineering colleges are controlled by Universities enjoying a large measure of autonomy which they jealously guard. It can never be the aim of University education, even technical or professional education, to cater directly to any Government service requirements; engineering colleges can therefore only provide basic technical training, which fits those who undergo it for entering the engineering profession. It is therefore usual for the colleges to offer only three courses viz. those leading to a degree in civil, mechanical and electrical engineering. These courses are usually broad-based and cover only the fundamentals of engineering science pertaining to each branch, though of course there is a considerable measure of common ground between the three branches in the initial stages. Completion of these courses provides a satisfactory starting point for subsequent specialisation in any particular field in the branch concerned. This is the usual pattern of technical education in most of the advanced countries of the world, though in certain universities there is a fairly wide choice of electives even at the under-graduate stage, which gives the semblance of specialisation to the course. This however is only a superficial semblance inasmuch as the electives are treated in an elementary manner. True specialisation requires not only advanced academic study, usually provided in a post-graduate course, but also intensive training in the practical details of design and construction of works.

64. One result of the autonomy enjoyed by the universities is that the engineering courses vary in different universities, particularly in respect of their duration. Thus some engineering colleges offer a four years course, some three; there are others which require one year's practical experience after the completion of the academic course before a degree is conferred, in which case the duration of an under-graduate course is increased to five years.

65. As regards content, most of the colleges devote considerable time to instruction in descriptive subjects like building materials, masonry and foundations etc.; others concentrate more on the basic engineering sciences viz. applied mechanics, hydraulics, theory of structures etc. Some also devote a considerable time to workshop practice, such as carpentry, fitting, filing etc. and on the revision of pure science subjects, which have already been covered or should have been covered before the student joined the engineering college.

66. Far too much time is also devoted in colleges to the teaching of professional details which the alumni can easily pick up after graduation, when they become working members of the profession.

67. A Joint Committee of the All-India Council for Technical Education of the Inter-University Board has examined in detail the question of duration and content of the basic courses offered by Indian Universities in civil, mechanical and electrical engineering and has suggested that the duration be of 4 years, including at least 6 months practical training. We trust that all Universities will adopt the suggestions made by this body. It is not however necessary that uniformity should be aimed at everywhere. There should be sufficient room for minor changes and variations within the accepted frame-work. In short, equivalence of content rather than complete uniformity should be the objective.

68. Also descriptive and discursive treatment should be eschewed as far as possible. The available time, which is all too short, would be utilised far more profitably in inculcating a scientific approach rather than imparting a mass of information. It is tragic that even today there are engineers in large numbers and sometimes in high places who do not appreciate the need of teaching higher mathematics in engineering colleges. Thumb rules have no place in modern engineering. Problems which confront engineers today vary so greatly in their nature, size, and complexity that what applies to one almost certainly will not apply to another and each will need to be analysed independently by reference to first principles. For such an analysis a sound theoretical background and specially a thorough grounding in mathematics are essential. The basic principles of soil mechanics, hydrodynamics, stress-analysis, etc.,—which have helped to throw light on problems hitherto but imperfectly understood—and their application to engineering become intelligible only to those possessing adequate mathematical equipment. The degree of skill in the use of mathematics as a tool for analysing complex problems required is such that it can only be acquired if the subject is studied in the early stages of an engineering course i.e. prior to embarking on the study of professional subjects. At present in most institutions both mathematics and other engineering subjects are studied side by side and there is hardly time to familiarise oneself with the mathematical processes to be able to apply them to engineering design problems. No wonder therefore that most of our engineering graduates are unable to follow articles published in foreign professional journals which in almost all cases are highly mathematical in their treatment. Post-graduate degrees have been instituted and courses leading to them have been drafted in almost all universities in India. Such courses, we have noticed, vary greatly in character. We have observed that in most of them there is considerable repetition of what has been taught at the undergraduate level. They also tend to be descriptive and very often superficial. We have also noticed that the questions set at post-graduation examinations are often exceedingly elementary. We believe that the main reason for this state of affairs is that in many cases the teachers of the courses are not of the high calibre required for guiding and instructing candidates for post-graduate degrees. Certain technical institutes and colleges, notably Roorkee, offer post-graduate diplomas in many engineering fields. They however attempt to cover far too many subjects in comparatively short courses, often of only a few months duration. For advanced work a more intensive study is called for, and post-graduate courses should aim at depth rather than breadth.

69. The two ways in which the Government can help in raising the standard of technical education in the country are :—

- (1) by offering financial assistance that will enable the Colleges to provide adequate accommodation, equipment and staff; and

- (2) by loaning the services of experienced Officers from the Government service cadres to serve as teachers in engineering colleges. This is all the more important in respect of irrigation and power engineering where practical experience is restricted almost exclusively to Government engineers.

70. As regards (1), during the First Five-Year Plan the Government of India has rendered financial assistance to a very large number of technical institutions for improving accommodation and equipment; while accommodation and equipment are important, far more important than either is the adequacy and quality of the staff and there is much room for improvement in this respect. We would accordingly strongly urge that greater attention be paid to this aspect in the Second Five-Year Plan period.

71. In most colleges the members of the teaching staff are the products of the colleges themselves who have neither acquired higher academic qualifications nor practical experience in responsible positions since they left the college portals. Many of them have risen progressively from the post of Demonstrator or Assistant Lecturer—to which they may have been appointed within a few months of their passing out—to the post of Lecturer and even Professor in the same college. Such men have often taken to teaching because of their failure to secure a better billet outside, and the only result that can be expected from them is that they will produce other men as helpless as themselves. In several States where there used to be only one or two colleges before the war, there are now often three to four times that number, and several members of the higher staff of these colleges have been drawn from the parent colleges. This has led to the impoverishment of the teaching standards in the parent institution without in any way ensuring the enrichment of the new institutions to which they have gone, because of the heavy dilution with inexperienced men in those institutions.

72. The straits to which many colleges are reduced in securing suitable staff and the manner in which they are forced to impress men from the lower categories into the higher is illustrated by the recent appointment in one well-known college of a Lecturer in Applied Mechanics to the post of Professor of Structural Engineering in the same college, on the understanding that he qualified himself on the designs side by a period of attachment to the Designs Office of the Chief Engineer, Public Works Department of the State, during his long vacation (3 months)!

73. The approach and the method and quality of the teaching in many engineering colleges have remained substantially unaltered for the last 20 years, and all new methods and approaches seem to pass them by.

74. Another important aspect affecting the quality of instruction is the number of admissions made to the engineering colleges. We are strongly of opinion that these numbers are far too large with the result that individual attention, which is such an important element in professional training, is almost wholly lacking. The over-crowding of engineering colleges has been aggravated in recent years in spite of the fact that many new institutions have been established since 1947. This is, firstly, because there

is a general feeling in the student world that a technical career today offers more glittering prizes than any other, so that nearly every one with ambition seeks admission to a technical institution even if he does not possess the ability to make the grade; and, secondly, because the newly-started colleges, which have been set up in many cases by private agencies acting in the belief that they were thereby helping the general development of the country, find it extremely difficult to make both ends meet and in this predicament have recourse to the usual devices of (a) increasing the admissions as much as the controlling universities will permit—and in this respect our impression is that the universities are far too complaisant—and (b) employing as few men on their staff as they can possibly get away with. Even some of the State Governments appear to regard it as their bounden duty to comply with the public demand that admissions to existing institutions be increased, without stopping to think whether they have the accommodation and the staff to cater to the additional numbers. Actually there are many Government Colleges throughout the country which are seriously understaffed, but have to manage with their increased numbers of students all the same, with the inevitable consequences that such understaffing brings in its wake. The Government could, we think make a very substantial contribution towards raising the standard of technical education in the country by insisting that no technical institution will qualify for a grant-in-aid unless it maintained a certain minimum ratio of teachers to the taught. This is as important as ensuring a minimum salary and security of tenure to the teachers and in both these respects and particularly salary, there is much room for improvement.

75. Ideally the teacher in an engineering college should have a sound theoretical training as well as wide practical experience, and it is impossible, in our view, to secure men possessing both these qualifications on the salaries offered in most institutions. To our mind, a Professor in an engineering college should draw the same salary as a Superintending Engineer, a Lecturer as an Executive Engineer, and an Assistant Lecturer as an Assistant Engineer, and all should draw a special pay of Rs. 150 per mensem in addition and the Principal Rs. 250 a month.

76. Coming to the question of the training of irrigation and power engineers, there is no justification, in our opinion, for providing more specialised instruction in their subjects than is now usually available as a matter of course in all colleges. It would be expecting too much of the universities to cater specially to the requirements of the irrigation and power cadres of the Central and State Governments when the recruitment to such cadres is only a comparatively small proportion of the total engineering personnel trained by the universities.

77. For instance, in the Bombay State the annual output of engineering graduates in the civil, mechanical and electrical branches is of the order of 850, whereas the recruitment required for the irrigation and power cadres alone, even with all the new projects envisaged under the successive Five-Year Plans, would be of the order of about twenty per annum only after the heavy initial demand is met. We are assuming of course that engineering graduates fill in only gazetted posts of the engineering cadres, and do not accept the posts of Overseers, as most of them are obliged to do at present. This point has been elaborated separately.

78. Not only do we consider that specialised academic training in irrigation and power engineering in the under-graduate stage is not feasible in the circumstances mentioned above, but we even feel that it would be undesirable, since such specialisation can only be achieved at the expense of the training in other subjects, which are equally important from the point of view of the engineer's general make-up, e.g., advanced mathematics, higher strength of materials, soil mechanics, etc. Any narrowing of the training in these subjects, which would inevitably result from an undue emphasis on irrigation and power-engineering, would leave the budding engineer woefully ill-equipped as compared with his confreres in the more progressive countries of the world. It is only while he is still at college that an engineer can be properly grounded in the fundamentals of his profession and acquire a correct and scientific method of approach to the problems with which he will later be confronted. It is a mistake to suppose that except in the rarest cases he can obtain this grounding or acquire this approach by unguided reading after graduation. The present trend in the advanced countries of Europe and America is to include these subjects in the basic engineering courses offered, and it is a good sign that a number of engineering colleges in India are doing likewise, but we wish that their importance were more fully appreciated and their teaching entrusted to properly qualified men.

79. Another trend much in evidence in Europe and America is the inclusion of the social sciences and industrial psychology, labour relations, etc., in the curricula of under-graduate engineering courses. These subjects are taught to some extent in our colleges also but we would like more time and attention to be devoted to them as a good grounding in them helps to qualify men for positions of the highest trust and responsibility in the profession and particularly for posts requiring administrative and managerial ability.

80. While the main object of our enquiry is to assess the numbers of technical personnel for the River Valley Projects to be undertaken in the country during the 2nd, 3rd and 4th Five-Year Plans and suggest the expansion of training facilities necessary to secure them, we cannot emphasize too strongly the need for Government always to bear in mind that *quality* counts more than *quantity* and that while expanding the number of training institutions, the quality of the teaching must not only not be allowed to suffer, but must on the contrary be progressively raised so that in the near future our engineering colleges and institutions compare favourably with the best of their kind in any part of the world.

81. In order to make the best possible use of our limited resources in talent and training it is necessary to ensure that engineering graduates should not be wasted in positions below their training and knowledge and this is happening at the moment in most State Public Works Departments. In most States, particularly in Southern India, the tendency appears to be to recruit graduates as overseers or subordinates as far as possible and thereafter to promote them as Deputy or Assistant Engineers and finally as Executive Engineers. This is to our mind a most unsatisfactory procedure. It is essential, in our view, in order to secure men of ability, integrity and professional independence to man the higher engineering cadres by direct recruitment from among engineering graduates. This applies to all officer cadres but more specially to the Class I cadres of the State Services. Starting graduates as overseers leads to such a scramble for promotion that unhealthy

and unfair practices are likely to arise—the overseers will not only rely on the quality of their work but will try to please their superiors by any and every means open to them. In this process many good men, who are unable or unwilling to adopt these methods and survive the brutal competition, may be trampled underfoot. Moreover, keeping a graduate for long in a subordinate position tends to give him a wrong psychology, and greatly impairs his usefulness, when at last he does secure promotion; in other words, working in a subordinate capacity for any length of time develops many complexes in him, which he finds difficult to shake off afterwards.

82. In view of the numerous colleges that most States now boast, it is essential that recruitment to the Class I and Class II State Services should be on the basis of a competitive examination. But in holding this examination the Public Service Commissions should, we suggest, be directed not to make their selections only on the basis of technical ability or competence but also to give due weightage to general knowledge, ability to express oneself clearly and forcefully, resourcefulness and qualities of leadership, all of which go to the making of a successful engineer officer.

83. We are glad to note that in most States there is a complete separation of cadres between the Irrigation and Road and Buildings Branches, with the notable exception of Bombay. How we can ever hope to acquire the desired efficiency in the design and execution of big projects, specially how we can terminate our dependence on foreign experts, for which the country passionately longs, it is impossible to imagine without at least separating the cadres of the two branches. In fact, mere separation of cadres alone is not enough; there must be specialisation and research within the cadres. This point has been examined in a subsequent chapter.

84. Considering the preeminent importance of the Irrigation and Power Projects now being planned in developing the country, and the magnitude and complexity of the work involved in their design, execution and subsequent management, it is essential that we should be able to harness some of the best talent in the country in their service. The State Class I engineering services show great disparity of emoluments, status, etc., and it is to be hoped that the quality of their work is not correspondingly affected. In order to secure the right type of men we would urge the creation of an All-India Service of Irrigation and Power Engineers, which will enjoy the same status, pay-scales and conditions of service as the other All-India services. We feel that only the prestige attaching to such a service will provide the needed attraction. Moreover, it is such an All-India service alone that can be expected to ensure continuity of policy and enable its members to exhibit greater independence of technical opinion than those belonging to purely State service—an important consideration if we bear in mind the possibility of different political parties holding power in different States or in the States on the one hand and the Centre on the other.

85. It should be noted that the States Reorganisation Commission has urged the revival of the Indian Service of Engineers. We would therefore press for the immediate institution of the proposed All-India Service of Irrigation & Power Engineers by an amendment of the Constitution of the country, if necessary, providing for such a service in the same way as it has provided for the I.A.S. and I.P.S.

86. Ideally, we think with Mr. Paul Appleby that there should be only one Civil Service for the whole country, and that administrators, police officers, engineers and others should all belong to sections of it. This will automatically ensure that the best talent in the country will find its appropriate field freely, without differences in pay and status tending to restrict them in their choice that they often do at present.



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CHAPTER V

POST-RECRUITMENT TRAINING

87. It should be obvious that an engineer's training cannot be considered to be completed when he leaves the portals of his college. In Europe and America it is taken for granted that the acquisition of a degree merely qualifies the engineer graduate to begin his professional career at the bottom of the ladder, where he will acquire all the necessary practical and drawing office experience for at least two or three years, before he can be entrusted with responsible work. In this country however both private and Government employers seem to regard a fresh engineer graduate as a finished engineer capable of taking over posts of trust and responsibility from the start. When the engineer graduate fails to come up to this unwarranted expectation he is often condemned as being unpractical and useless. Nowhere is the need for practical experience more necessary than in the field of irrigation and power engineering and it is therefore evident that after recruitment Government should provide a planned programme of practical training that will fit the young recruit progressively for positions of greater and greater responsibility in his service. In our opinion the initial period of training should extend over at least a couple of years during which the young recruit should be considered to be on probation. During these two years he should be required to spend a stipulated period on survey work, on design in the Designs Office, and on construction of new works and operation of completed works, before he is confirmed and placed in charge of a subdivision. This used to be the type of training imparted to the India-recruited members of the Indian Service of Engineers during the British regime and it should be revived immediately. The present practice is in most cases to attach a recruit to the nearest Sub-Divisional Office and to leave him more or less to his own devices. Even when a recruit is posted to a particular Division because an important work is being designed or constructed in that Division, it is essential to see that the recruit is under an Officer who is truly interested and sympathetic and who regards the training of the recruit as a part of his normal duties, and takes a special pleasure and pride "in teaching the young idea how to shoot". The counsel and guidance afforded by a senior Officer should relate not only to purely professional and accounts matters, but also to the much more intricate but nonetheless important matters of departmental etiquette, relations with Officers of other Government Departments, and with members of the public etc. A certain amount of social guidance is also necessary as it is impossible to separate this aspect of one's life from the official aspect.

88. As regards professional training, apart from the purely technical side, which will be no doubt attended to in the field and drawing office, engineers should be trained in the normal accounts procedure of the department and it is therefore recommended that an "accounts and procedure" course of six weeks or two months duration should be organised at regular intervals. This course will obviously apply to Officers of all grades and may even include subordinates; it should be taken during the two years' probationary period.

89. A common but well-deserved charge that can be levelled against most Government Engineer Officers is that they are so much immersed in official routine that they have little time and less inclination to keep abreast of the technological advances in their branch of engineering. With a view

to enabling them to do so they should be encouraged, when they are still young, to take post-graduate courses and specialise in particular subjects at universities offering specialist courses. It is not suggested that everybody should do a post-graduate course, but some positive encouragement should be held out to those who show an inclination for higher academic study. All engineers however should be required to take refresher courses at periodical intervals, say every five or seven years. These refresher courses, which should ordinarily be of not more than 3 to 4 months' duration, should be organised at established institutions and should afford the Officer trainees the opportunity of catching up with the latest advances in their field of work, both on the theoretical and practical side. Officers attending refresher courses should of course be regarded as being on duty. We suggest that the first refresher course should be taken by the Officers after recruitment at the end of five years and should cover the following subjects :—

- (1) Hydro-dynamics with application to current problems.
- (2) Design and construction of dams of various types.
- (3) Analysis of stress in dams, e.g. trial load analysis etc.
- (4) Underground water-supply.
- (5) Detailed study of one or two projects, with actual visit to sites.
- (6) Application of soil mechanics to engineering problems.
- (7) Concrete Technology.

90. If the number of Officers taking the course in any State is small, such a course, we suggest, is best organised on an inter-State basis, or it may be organised by the Central Government. This will not only enable a sizable class to gather, but will also promote exchange of ideas and experience relating to States and regions and promote *esprit de corps* among irrigation and power engineers. Further, able instructors being few and far between, this centralised refresher course would ensure the best use being made of such as are available.

91. It may be mentioned that the refresher courses are not intended to take the place of post-graduate courses offered by the universities, for which it is hoped some Officers will qualify themselves as already mentioned above. The refresher courses should not therefore be excessively academic, and the primary object should be to introduce Officers to the latest developments in engineering science and to substitute the rough-and-ready rule-of-thumb measures so largely adopted in their work by a more rational and scientific approach.

92. Incidentally in view of the enormous advance that the progressive countries of Europe and America have made in the field of engineering and technology, it is desirable that Officers should, if possible, have the benefit of training, both theoretical and practical, in and through selected universities of those countries. To enable this to be done special scholarships should be offered on a more liberal scale than is done at present and the study-leave rules should be greatly liberalised so that almost anybody who fails to get a scholarship can benefit by a foreign course at his own cost, as provided under these rules.

93. Visits to important works at home and abroad should also be permitted freely and the expense involved should be borne by the State in whole or in part, depending on the merits of the individuals. The common excuse

made that owing to the present dearth of experienced men nobody can be spared either for study or visits abroad should not be allowed to stand in the way of foreign travel or foreign study, though it is evident that such study or travel, if freely availed of, will have to be on a carefully planned basis.

94. We have been surprised to see that in spite of many large and important works under execution in this country such as those relating to the Vaitarna, Bhakra-Nangal and D. V. C. Projects the number of engineers, who have visited these works, has been microscopically small, and the few who have visited them appear to have spent only a few hours at the site or at the most a day or two. When we recommend visits to works, we mean visits of sufficient duration to enable a thorough study to be made of the design, construction techniques and economics of construction. The tragedy is that much more time is devoted to such study during visits to works in foreign countries than to works at our own door-steps though the lessons to be learnt may be quite as valuable. The Central Water and Power Commission has often provided all the facilities for visits to important works in process of construction at home, but these facilities have rarely been properly availed of.

95. Seminars and Conferences, we are pleased to see, are held periodically under the aegis of the Ministry of Irrigation and Power. They serve as a clearing-house of information and ideas. Their chief value in our opinion lies in the fact that they stimulate thinking and arouse the interest of those who are ordinarily apathetic. But like all good things, they have their limitations and to be really useful should be held only about once in two years and attended only by selected persons. The subjects to be discussed should be selected in advance and sufficient time should be given to the participants to make a useful contribution in the form of papers, notes and memoranda. Routine problems which can be dealt by the circulation of printed material or through correspondence should be avoided and the discussion should be brief and businesslike. While this has been the avowed aim of seminars held in the past, we cannot say that it has always been achieved in full measure.

96. We suggest that, for the future, seminars should confine themselves only to subjects of most urgent interest and their venue should preferably be near the site of works where it is possible to see the practical side of the subjects chosen.

97. With a view to preparing Indian Officers to assume positions of the highest responsibility in the planning and execution of projects, it is necessary in addition to providing facilities for study-leave and encouraging visits to works at home and abroad, etc.; to institute a Staff College wherein the socio-economic, administrative and practical aspects of the planning and execution of big projects can be studied. The subjects covered at the Staff College should include the following :—

- (1) Nature and dimensions of irrigation planning State-wise, region-wise, and country-wise.
- (2) Co-operation between States and how to secure it.
- (3) Enlistment of public co-operation and active association of the public with constructional activity.
- (4) Criteria for determining the feasibility and suitability of irrigation projects, viz. financial, administrative and social.

- (5) Study of experience gained in recent projects.
- (6) Statistical study of various aspects of irrigation and power planning, viz. silt control, flood flows, irrigation intensity, duties, relative merits of various types of dams, different aspects of water planning, multiple versus single reservoir, capacity of reservoirs, capacity of channels, control of transit losses, flood control, planning of agricultural production, sugar industries, fruit farming, dairy farming, etc.
- (7) Afforestation problems and their relation to control of silt and floods.
- (8) Contractual versus departmental agency for execution of projects.
- (9) Recent trends in construction and organisation.
- (10) Capital-intensive and labour-intensive methods of construction.
- (11) Planning on a socialistic pattern, its implications and the modifications required in the existing methods.
- (12) Development of power-load and assessment of rates, depreciation etc. Yardsticks for evaluation of benefits from existing projects and current price trends.
- (13) Rural electrification.
- (14) Relationship between various aspects of utilisation, viz. Irrigation and Power generation, etc.
- (15) Departmental organisation at State level, project level, preparation of notes and manuals.

98. As regards the location of such a college, we feel that Roorkee which has recently set up a Water Resources Development Training Centre would be a suitable place. Details of the proposed staff college will have to be worked out in consultation with the University authorities and the State Governments.

99. At this point we would like to suggest that facilities should be offered to engineer Officers of the irrigation and power cadres to attend the Administrative Staff College which is being planned. This would provide them opportunities to meet Officers of other services and high industrial and business executives and thus give them a broader view of their duties and responsibilities. It would also help the non-engineer participants in the Administrative Staff College courses to see how irrigation and power projects fit into the general pattern of the country's overall development.

100. The Officers taking the Staff College course should be carefully selected men of the rank of executive engineers and superintending engineers who show promise of reaching the highest positions in the service; in other words, the staff colleges are not intended for every senior officer.

CHAPTER VI

DEPARTMENTAL ORGANISATION AND EFFICIENCY

101. As we have already observed, in most of the major States separate cadres already exist of irrigation engineers. One of the notable exceptions is Bombay where the Irrigation and the Roads and Buildings Branches have still a combined cadre. Electrical engineers generally constitute a separate cadre by themselves and often there is a separate Electrical Department altogether. Every technological advance pushes out the frontiers of knowledge so far that it is impossible now for any officer to be equally at home in all fields of engineering. Moreover with the enormous irrigation and power projects now being undertaken in nearly every State it is obvious that only very highly specialised personnel with experience and skill can cope with the problems that will crop up in the planning and execution of these projects and the subsequent operation of the irrigation and power systems that they establish.

102. It should be exquisitely superfluous in the middle of the 20th century to labour this point, but in view of the attitude of some States we think it desirable that the Central Government should take whatever measures lie in its power to bring about this separation of cadres. Not only is this specialisation in this broad fashion essential and indeed inescapable for progress and efficiency, but further specialisation within the branch itself should also be the main aim; these however are matters of detail which we need not examine here.

103. The constitution of the Public Works Department on which has fallen the burden of implementing the country's present ambitious developmental programmes, was fashioned in the latter half of the 19th century and was no doubt suited to the needs of those days. With the present complexity of engineering problems and more particularly with the enormous size of the construction programmes, and the pace at which constructional activity is being pushed forward, the old P.W.D. structure is quite incapable of meeting the needs of the time and, as far as we have been able to judge, has shown signs of excessive strain already. The setting up of Special Project Organisations or Formations to execute some projects is in itself an admission that the P.W.D. structure is unable to face up to its present tasks. The basic feature of the P.W.D. is the organisation of territorial charges, with subdivisions constituting the primary cells of the department and aggregates of four or more sub-divisions constituting a division, and four to six divisions constituting a circle. Normally all works of construction and maintenance are looked after on a divisional basis. Territorial charges should, in our opinion, now be restricted purely to the maintenance and operation of works. All planning and construction of major works should be organised on a functional or specialist and not on a territorial basis. This is already the pattern in the case of major projects, but we would recommend its extension to all projects as far as possible. Such a functional basis for planning and construction charges will only be feasible with the creation of specialist cadres and sub-cadres. Thus some Officers may concentrate on design and construction of earthen dams, others on masonry or concrete dams; the design of canals can also be a separate charge. Each one of these subjects requires specialised study and special experience over a period of years. If such experience is to mature and be utilised for the benefit of future works

it is obvious that the men possessing it should continue to work in the same field. In the field of power engineering too there is considerable room for specialisation. Thus thermal generation requires a life-time's study and experience; so does hydro-power generation. Again the plant and machinery installed in generating stations, distribution of power, utilisation—all these are fields where long experience and detailed knowledge are essential. Our aim should be to utilise the experience and knowledge of Officers to the best advantage of the country, especially as the techniques of construction are registering constant improvement and unless one is in the closest touch with these developments one is left hopelessly behind. Incidentally, as we have pointed out in Chapter VII, our lack of specialisation is one of the reasons why this country is still dependent on foreign experts; lack of confidence also proceeds from the same source.

104. Applied research by departmental Officers also plays an important part in the advances made in developing local practices and techniques. Officers showing an aptitude for research should be encouraged to engage on it. Every State should set up a research station of its own, and Officers working in research stations should be provided with sufficient incentive to make it worth their while to devote themselves exclusively to their science without coveting the plums of normal service. It is therefore necessary to compensate such officers by the payment of adequate allowances. The benefit of the "next below rule" might, it is suggested, be allowed in their case.

105. The State research stations will deal primarily with local problems and their work can be co-ordinated by the Central Board of Irrigation. As regards the Hydro-Dynamical Research Station at Khadakwasla, it deals with work of such great importance relating to so many different departments e.g. docks and harbours, navigation, river training, flood control, ships, etc. that we feel it should be free from all departmental affiliations which may tend to hamper its activities, such as shortage of funds, administrative interference, etc. and should be constituted into a National Laboratory on a par with the other National Laboratories in the country. The Central Water & Power Commission, the Central Board of Irrigation and the various departments of the State and Central Governments will then submit problems for investigation to this National Hydro-Dynamical Laboratory in the same way as other problems are sent to the other Laboratories. Thus constituted the Hydro-Dynamical Research Laboratory will, we are confident, soon develop into a Laboratory to which problems from all over the Middle East can be referred. We would however recommend that the Laboratory should confine itself purely to hydro-dynamical problems, and the work done in the field of concrete technology, soil mechanics, stress-analysis, etc., should be only in an ancillary capacity, i.e., only to the extent that such work is necessary for the elucidation of the hydro-dynamical problems under investigation.

106. It has been pointed out to us that at the moment the Hydro-Dynamical Research Station is chiefly engaged with large-scale and urgent problems of flood-control, river-training, silt training etc., referred to it for investigation by the Central Water & Power Commission. It may therefore be necessary to accord such and similar problems a high priority in the investigations of a National Hydro-Dynamical Research Laboratory constituted on the lines suggested above to ensure that the work of the Central Water and Power Commission does not suffer in any way. It may

even be necessary in the light of experience to expand the National Hydro-Dynamical Research Laboratory to provide a section devoted exclusively to the work of the Central Water & Power Commission or even to establish a separate Research Station under the direct administrative control of the Central Water & Power Commission for the investigation of its own immediate problems.

107. In the interest of efficiency and quick disposal, it is essential that every Officer must know his exact responsibility, in other words, the nature of his duties and the limits of his authority should be clearly defined. It is only in this way that an Officer can be made to shoulder responsibility, instead of trying to avoid it, which he is often prone to do, specially in the prevailing circumstances. Interference in his own sphere of responsibility and authority should be eschewed, as it only leads to frustration and the Officer in disgust refuses to shoulder any responsibility at all. In this connection it is particularly necessary to emphasize that in the Public Works Department set-up the separate responsibilities of the Secretary to Government and the Chief Engineer should be clearly recognised, even if the two charges are held by one and the same person and much more if they are held by different persons.

108. Almost from the time it ceased to be an offshoot of the Corps of Royal Engineers and was constituted into a regular civil department of Government's, the Public Works Department had its head functioning in the dual capacity of Chief Engineer and Secretary to Government in most of the old Provinces and States of what was then British India. The arrangement appears to have worked satisfactorily though at various times proposals to separate the functions of Chief Engineer from those of Secretary were mooted, in some cases the intention being simply that the two offices should be distinct but both held by engineers. Nothing came of these proposals. In Madras alone of the bigger provinces, the Secretary to Government has been a non-engineer for many years now. It is of interest to note that in Mysore, which has always been regarded as one of the most progressive States in the country, particularly in the field of engineering and technology, the two offices of Chief Engineer and of Secretary were both held by Engineers.

109. In 1949 it appears to have been the general policy of the State Governments to separate the duties of the two posts and to appoint a member of the civil or administrative service as Secretary. It was apparently argued that some one was necessary to keep the experts in check, and to give the Ministers his advice on the economic and administrative aspects of their projects. At first blush this argument appears to have considerable force; but it assumes firstly that the engineer is a narrow specialist, quite incapable in his enthusiasm of taking a broad view of things, and secondly it overlooks the fact that the enthusiasm of a non-expert can be quite as dangerous as that of the expert. The engineer of today is not always a narrow specialist and in fact only those engaging in research and restricting themselves to only one field could be regarded as such, if at all. The average engineer in charge of a Division and much more an engineer in charge of a Circle has also to be an administrator, and has to take into account economic and other factors—even public psychology—if he is to make a success of his job. These remarks apply *a fortiori* to Chief Engineers and generally to the upper echelon of the profession.

110. As regards the enthusiasm of the non-expert, as Mr. Henry Maddick, an English expert in Administration, who lectured in the country recently, observed during the course of a discussion with the Chairman, there is no person more dangerous than the layman with pet ideas. On a balance it would not be too much to say that the layman in a position of authority needs as much to be kept in check by the expert as the expert by the layman. In our case since the Minister and Deputy Minister are themselves laymen and since in any case a Public Works Department project would be scrutinised by officials of the Finance, Revenue and possibly Agricultural Departments—particularly an Irrigation and Power Project—it is not understood why an additional layman should be interposed between the Chief Engineer and the Minister. Besides, the best way of keeping an expert in check is to employ another expert, which would be an argument for separating the functions of Chief Engineer and the Secretary by appointing an Engineer-Secretary. An Engineer-Secretary would certainly bring to light the weaknesses or doubtful points of a project more easily than a layman Secretary, and it would then be easier for the Minister with the help of the Finance and Revenue Secretaries, both laymen themselves, to come to the correct decision about it.

111. As the Chief Minister of a State and one of the top-most national leaders informed the Chairman and some members of the Committee during the course of their discussion with him, the time has come when Chief Engineers and other experts must consider it their duty to inform their Ministers what cannot be done in their own field without fear or hesitation. This would be a simple matter if they had not to contend with laymen secretaries who from ignorance of the technical issues involved or from their normal policy of pressing the ministerial point of view could seriously hamper or delay the developmental programmes and activities.

112. As we have already pointed out earlier, the magnitude and complexity of modern engineering projects is such that it is well-nigh impossible for a mere administrator, who may only have been a District Collector for a few years before being appointed as Secretary, even to grasp all their implications or understand their true significance and this fact has been recognised by no less a personality than the Prime Minister himself, who in his address to the meeting of the Standing Committee of the National Development Council on 7th January 1956, said: "I think that the scientific and the technical personnel should be introduced not only in the technical processes but in the administration also. The administrator is an able man and does a good deal but his thinking is on different lines than that of a technical man. I think there should be greater inclusion of that type of thinking even in our administration. They should come in and I think it is better to mix the pure administrator with the technical man and the scientific man. After all, all the problems today are problems of science and technology. An able administrator or an able politician, just like an able lawyer, can grasp the main problem to argue this way or that but it is one thing to argue from the broad outline and another to have grown up with that idea in the process. I think, therefore, the scientists and technicians should be associated more and more with our various processes including administration and planning."

113. We would therefore, strongly urge that this source of friction and bickering within the P. W. D. itself should be ended once and for all. We refer here of course to Secretaries to State Governments, who are concerned directly with the execution of projects

and not to Secretaries to the Government of India who are concerned primarily with policies. In many provinces there are Chief Engineers of 25 to 30 years experience who have to work with I.C.S. or I.A.S. Secretaries, who have put in about half their service. There was bitter complaint of the attitude of some of these Secretaries, who seem to regard themselves as Heads of the Department, which they of course are not. An instance was quoted of the Secretary to Government, P.W.D. of a certain large State in a public conference of senior engineers attended by the Minister and Deputy Minister, speaking of the Chief Engineers of the State as "my Chief Engineers" and being corrected by one of the Chief Engineers present: "Not your Chief Engineers, Mr. Secretary, but Government's Chief Engineers." This incident is mentioned because it typifies the attitude of the Administrators towards technical men who strongly resent being regarded and treated as subordinates of the Secretaries, when in point of fact they are departmental heads and the top technical men of the State, whereas the Secretaries have no technical or financial powers of their own.

114. Apart from this strong feeling of resentment on the part of the engineers, the enormous time wasted in explaining things to a layman Secretary and then explaining them all over again to the Minister has been repeatedly pointed out to us.

115. The best arrangement would appear to be to make the Chief Engineers also Secretaries to Government but where this is not feasible because the technical work-load is too heavy, the Secretary should also be a senior, though not necessarily the senior-most, engineer. But whether the Secretary is an engineer or a layman, and perhaps even more when he is a layman, it is essential for the smooth and efficient working of the department that the following observations of the Gorwala Report on Public Administration should always be borne in mind by the State Governments; "One of the best examples of an organisational defect in which one branch of the administration encroaches on the functions of the other is furnished by the relationship between the Secretariat, that is, the Ministry, and the head of the department working under it. Here although the limits of action of both are very well known, the Ministry being responsible for the formulation of policy, and the department for its implementation, yet often so great is the anxiety of the Ministry to see the work carried out that it continuously interferes. The result is that the head of the department is deprived of all initiative and instead of being allowed to attend to and make progress with his own work, has to spend a great deal of time submitting unnecessary reports, explaining the position in individual matters to the Ministry and getting its orders on points which lie well within his own sphere of authority. The attempt by a Ministry to do the work of the head of a department invariably ends in inefficiency and failure. The work is delayed, it gets badly done, and when things go wrong, there is no single person who can be held responsible. The departmental chief and other officers lose heart and all that occurs is waste of time, men and material ending in lack of success of policy. It would be infinitely better to let the departmental head to his own work, keeping an eye on it from a distance and asking for periodical reports to see how things were going. If by such behaviour the Ministry won the confidence of the departmental head he would of his own accord bring in good time such difficulties in which he wanted the Ministry's assistance to it, instead of grudgingly resenting it, as he does, when continuously harassed. If the desire is that work should be done well, the rule should be

'allot it to a man, fix his authority and let him have a free hand within that authority. Give advice only when absolutely necessary. Note carefully, without interference, how the work is being done. If the man is not satisfactory, change him, but don't interfere unnecessarily.'

116. Instances are common of the Ministry calling in the Departmental Head for far too many discussions, often about trivial matters, and thus wasting the technical man's time to no purpose. Instances are also not infrequent when heavy pressure is brought to bear on technical men by the Ministry to submit schemes that are imperfectly investigated and even to start work on them before all details have been worked out, simply to ensure that there may be a flow of grants from the Centre to the State, which are in danger of drying up if the submission of projects is delayed, or work on them is not undertaken as scheduled in an ambitious but unrealistic phased programme of construction.

117. So far we have dealt with the stresses and strains arising within the Department when the Secretary is not an Engineer Officer. Mention must also be made of the friction at District and Divisional levels between the engineers on the one hand and the officers of the other Departments, especially the Revenue Department, on the other. In the old regime the Collector of a District while undoubtedly regarded as Head of the District, generally maintained correct and cordial relations with the Executive Engineer of the District, who however was not subject in any way to his authority (except of course in times of emergency) and who took his orders from his own superiors. The Collector's position *vis-a-vis* of the Executive Engineer and of the other District Officers even though he exercised direct control over some of the latter (e.g., the D.S.P.) was that of "*primus inter pares*." Today there seems to be a marked tendency for the Collector to regard himself as the Head of the District in the same way as a General Manager regards himself as the head of a big business or industrial organisation. All Government's developmental programmes in every Department are co-ordinated by him but he sometimes tends to forget that *co-ordination does not mean subordination*, and that the other District Officers are not his subordinates. The position has been aggravated by the fact that many Collectors today are extremely young men with little experience even of revenue administration, and it is fairly easy for such men to tend to drive the officers associated with them in their districts rather than to lead them forward to the goal set by Government. This failure in human relations is much more serious than is realised and has led to undesirable repercussions on the efficiency and morale of the engineers who if they are to give of their best must be restored to the old relationship with the Collector which existed before independence.

118. As in this First Five-Year Plan which has just ended, so also in the Second Five-Year Plan which has just succeeded it, the engineer will be responsible for the expenditure of anything between half to two-thirds of the financial appropriations under the Plan. He was and will continue to be required to fill a crucial role directly and indirectly in the public and the private sector; and the success or failure of the plan and of the other plans that will doubtless follow depends in no small measure on the success or failure that the engineer achieves and the fidelity with which he discharges his obligations. On more than one occasion the Prime Minister has stressed the pre-eminent importance of the engineer and the scientist in the context

of the enormous developmental programmes that must be planned and executed if the country is to be lifted from its present extremes of poverty and backwardness to a reasonable level of national well-being and its rightful place in the comity of nations. Speaking to a meeting of the general services not long ago at Kurnool, the Prime Minister said—"The person who is important today is the engineer, the scientist and the technical man. . . . The fact remains that the type of specialised work like that of the engineer or scientist is becoming more and more important. . . . the future of the country will depend more and more on them rather than on the administrators."

119. On another occasion referring to the enormous leeway the country has to make up and how fast it must move he said—"What Europe and America have achieved in 150 years, India must achieve in 50 years."

120. Considering the engineer's pivotal position in the successful implementation of the Plans, it should be the endeavour of Government not only to make the engineer a contented but an enthusiastic worker determined to discharge the responsibilities that destiny has placed on his shoulders with all the skill and courage and endurance of which he is capable. While it is readily conceded that in this difficult transitional period all Indians must make special sacrifices for the common good and that the services in particular must be animated by a desire to give of their best irrespective of their salaries and service conditions, we would like to emphasise the necessity of equality of sacrifice between all sections of the population and particularly between all the Government services. In the United Kingdom the Royal Pay Commission is a permanent body that reviews periodically the pay structure of Government Officers and one of its important findings after the last World War is that everything should be done to attract the highest grade of personnel to the technical services of Government, and that their emoluments should not be determined in relation to the other services, but must conform to the emoluments of technicians in non-Governmental undertakings. We would not go so far as to propose that the rich rewards offered by big business and industry to its higher technicians and executives should be paid to our engineers but as we have remarked in an earlier chapter if we are to attract some of the best talent in the country to its engineering cadres, they must at any rate be offered the same pay scales and conditions of service as the members of the I. A. S.

121. It is almost incredible, but nevertheless true, that even in the relatively simple matter of travelling allowances the I.C.S., I.P., I.A.S. and I.P.S. are in a class apart in many States, and engineers, even very senior engineers, are forced to travel in a lower class on the railways than the members of those services, e.g. an Executive Engineer getting Rs. 500 a month draws second class allowances whereas a member of the Administrative and Police services drawing less pay can travel First and even a Chief Engineer drawing Rs. 3000 cannot travel by air-conditioned coach whereas a member of those services getting Rs. 1600 and over can do so. These anomalies should, in our opinion, be redressed forthwith.

122. Status is no less important than emoluments. Human nature being what it is, engineers like any other body of men crave for the esteem of their fellow-men. True social approbation is of course gained only by the strength of one's character and the value of one's work; but in the case of Government servants particularly in our own country a certain amount of it also attaches to their position in the official hierarchy, with the higher

ranks of which it is traditional to associate "front seats in the synagogue and salutations in the market place." We cannot expect engineers to display a philosophic detachment and high-souled devotion to duty irrespective of public praise, if their compeers in Government service in other departments are given pride of place at official functions and even officially-sponsored social gatherings. As more than one Chief Engineer pointed out to us with great bitterness the official precedence accorded to Collectors and Superintendents of Police and the general fuss made over them would appear to indicate that we are still strongly influenced by the notions of prestige that marked the imperialistic age preceding Independence. The scant regard shown by the State Governments for its Engineer Officers is seen from the fact that they are rarely invited to meet visiting notabilities, whereas the local members of the administrative and police services are invariably presented to them. A case has come to the notice of the Committee in which when a magnificent new Secretariat building which was designed and constructed by the local P.W.D. officers in record time was opened by the Governor of the State in the presence of a distinguished gathering, the Executive Engineers and the Architect directly responsible for the building were not even presented to the Governor, in spite of the fact that a special plea had been made by the Chief Engineer to the Chief Secretary in this behalf long before the ceremony.

123. As regards day to day working, the present administrative and technical powers exercised by officers of various grades are, in our opinion, too low under present conditions. The result is that quick decisions cannot be taken in most matters and cases are referred to higher authorities for orders and there is a general tendency to push files around. All this increases the concentration of work at higher levels, delays progress and leads to general lowering of efficiency and morale.

124. In the sphere of finance particularly we suggest that the power of the various departmental officers should be substantially enhanced to conform both to the prevailing price levels and the needs of a developing economy.

125. Not infrequently serious dislocation of work or slowing down of progress results from the inability of local Officers to authorise small unforeseen items of expenditure or purchase of stores. Here again the system calls for drastic overhaul and liberalisation. Cases are not unknown where for the sake of a small spare part, plant and machinery have had to lie idle for long periods.

126. Similarly Officers should be empowered to make direct purchase of stores within fairly wide limits. The whole aim should be to keep the ball rolling i.e. to keep the whole organisation going, rather than to hold up work indefinitely, because a long and detailed procedure, which appears to be based on general distrust, has to be complied with.

127. The posting of all staff should be the responsibility of the Departmental Head whose advice in this regard the Ministry should always accept except in very special circumstances. He is like the Commander-in-Chief of the Armed Forces to whom the Government can dictate the strategic objectives to be gained but must leave tactics to be followed in the field or the men to be deployed to him. Thus the broad policy and socio-economic objectives of a project can be defined by the Government but the detailed execution and especially the actual personnel set-up should be left to the Chief Engineer and his subordinates.

128. We have assumed, in sketching the all-India picture of technical personnel requirements for river-valley projects included in the Second and subsequent Five-Year Plans and in making our proposals as to how they are to be met, that it is possible to equate surpluses in any one area or Project Formation with the deficits in other areas or Project Formations after allowing for certain transference losses due to the immobility, in varying degrees, of various categories of technical personnel. In point of fact this assumption would be justified only if there were complete accord and co-operation in this regard between different areas and Project Authorities. In the interests of economy and the most fruitful deployment of our technical personnel, Projects would also have to be phased to allow a continuous and orderly movement of various kinds of technical talent and experience from Project to Project as required. Unfortunately these ideal conditions simply do not exist; on the contrary each State tends to function as if it were working in isolation from its neighbours, and the only co-ordination and co-operation between States is that enforced on them in the process of exploiting common water resources; the States then come together, or, more often, are brought together by the good offices of the Centre for the purpose of constructing works of mutual benefit. But there is generally speaking no co-ordination at the *planning* stage, and the *phasing* of projects as such is never considered. We therefore feel that for the optimum use of our limited resources in technical personnel and experience, the first thing that needs to be done is to build up planning and construction organisations for river-valley projects on a comprehensive and rationalised basis.

129. Projects undertaken by individual States in isolation and for limited or unrelated purposes as they were, by and large, in the past, were not always or necessarily in the best interests of the country as a whole, and for the optimum development of our water resources on a comprehensive long-term basis, planning as well as execution of our river-valley projects should, as their very name implies, be related to a complete river-valley or basin as far as possible, the competing claims of the different basins being woven into a co-ordinated pattern of national development by the Central Government according to an approved order of priorities based on technical, economic, sociological and political considerations.

130. It would clearly be in the interests of the States and the Centre if both co-operated in setting up a well-planned organisation or organisations specially created and streamlined for achieving the targets of the country as a whole as well as its component units, as naturally demarcated by the great river-systems.

131. Three alternative types of organisation could conceivably meet our requirements :—

- (1) a central organisation charged with the responsibility of planning and executing the projects all over the country;
- (2) an independent organisation or organisations set up in each State to deal with those projects or parts of projects that directly concern the State;
- (3) zonal organisations, the country being demarcated for the purpose into five, or more zones, each zone covering one or more complete river basins, as far as possible.

132. As regards (1), it is becoming increasingly apparent that a vast country like India with so many soil-climate complexes and types of irrigation practice could not be covered by a single authority with the desired degree of efficiency and economy. Moreover the States would almost certainly be unwilling to subordinate themselves completely to such a single authority, that not merely advises but plans and executes all projects. They would always claim that they had special problems peculiar to their areas, into which they had a better insight than any Central Authority, and that local talent and patriotism could be better geared to local development through their own agency. Already the C.W. & P. C. no longer undertakes the execution of projects, except such as are entrusted to it by the States themselves. In any case in order to meet the needs of the whole country fully, a central organisation would have to be so large that it would inevitably become unwieldy and inelastic, and thus forfeit most of the advantages accruing from centralisation.

133. As regards (2) viz. an independent organisation in each State, the difficulty is that the organisation would have to co-operate with its opposite number in other States much more closely than there is any evidence of at present, if there is to be an integrated basinwise development. The inevitable clashes over the division of available flows from the basin could no doubt be resolved by the usual methods, but the possibility of having a common storage reservoir or head works or of sharing a common canal would be likely to be overlooked, with each State thinking in terms of its own boundaries and its own exclusive requirements. Moreover as each State would normally employ only persons possessing its own domicile, not only would the planning and administrative staff be considerably larger than under a system of regional development but also the movement of executive and work-charged personnel and of construction plant and equipment from project to project, irrespective of State boundaries, would be greatly impeded, if not altogether blocked. Thus on all counts independent State organisations would be wasteful of men and money, and might even be wasteful of time, a commodity of great value if we consider the country's ambitious programme. Finally the smaller States might not possess the resources in men and experience to make any headway at all with their schemes, even though these schemes were given high priority in the all-India programme.

134. As regards (3), viz. Zonal Organisations, workable zones might be as under:—

- (a) North-West Zone—covering the basins of the tributaries of the Indus flowing through this country.
- (b) North-East Zone—covering the Ganges and Brahmaputra Valleys, but excluding those of the tributaries of these rivers falling in (c) and (d) below.
- (c) West-Central Zone—covering the basins of the rivers in the western half of Central India, e.g. Chambal, Banas etc.
- (d) East-Central Zone—covering the basins of the rivers in the eastern part of Central India, e.g. Mahanadi, etc.
- (e) South Zone—covering the valleys in the peninsular part of the country, e.g. Narmada, Tapi, Godavari, Krishna, Cauvery, the coastal river valleys etc.

(The above list is purely illustrative and could of course be modified as required.)

135. Each Zone might again be sub-divided into sub-zones or regions, each covering a separate river or its important tributaries. The States having a direct concern, jointly and severally, with these zones should co-operate to set up some form of development authority, to be known as a Development Board, for each Zone. Development Boards should be constituted under an Act of Parliament, and the members of each Board should be appointed by the Centre in consultation with the States concerned and comprise officials and non-officials drawn from these States. The Board would then appoint its administrative and executive officers, as a rule, from amongst the State Cadres. Details will have to be carefully worked out, but the legitimate interests of each State would have to be safeguarded in this regard. The Development Board's officers would plan and execute all river-valley projects and flood-control works within the zone according to an agreed, continuous and phased programme, thus securing a better utilisation of experienced personnel and also of the construction plant employed by moving both from project to project. The Development Authority's officers should normally revert to their parent States after a reasonable tenure of office with it and be replaced by fresh incumbents drawn from the State cadres. This two-way flow of officers from the States to the Board and back to the States would ensure fresh blood and local experience always being available to the Development Board and the experience and broad outlook obtained with the Development Board being in turn available to the States. Moreover the great difficulty now experienced by existing central organisations, such as the Central Water and Power Commission in getting the States to spare officers possessing ability, initiative and drive for service with themselves would not apply in this case, since the States would have a direct interest and stake in the working of the Development Boards, as all important projects in the constituent States would be planned and executed by the Development Board concerned. The mobility of the lower category of technical personnel such as Overseers, Technical Assistants, Mechanics, Tractor Operators etc. would also be better ensured within a zone since, generally speaking, conditions of work would be uniform in the zone and the men would not have to go very far from home. It is necessary to emphasise that the Zonal Authorities would be concerned only with the planning and execution of projects and that the management of the works after completion would vest in the States concerned, except where joint management was separately and specifically provided for by mutual consent in respect of common works. Further a single State, if large enough, could comprise a whole zone; on the other hand, a single State might participate in more than one zone.

136. The present pattern of organisation appears to be some sort of combination of the first two types, with the C.W. & P.C. undertaking only a limited liability for basic planning and construction and the States undertaking the rest, with *ad hoc* Corporations or Control Boards specially constituted by the Centre for some specific projects and in the case of the Corporations, apparently not faring too well in their relations with the States concerned. The third type of organisation would therefore appear to afford the best means of securing that vital element in all development plans, the close co-operation of the States affected, because it strikes the correct balance between local patriotism and the national interest.

137. The setting up of zonal development authorities was proposed by us in a note specially prepared for consideration at the meeting of the Co-ordination Board of Ministers held in New Delhi in October 1954. It

also formed the core of the recommendations embodied in the Interim Report, which was discussed at the Seminar held at Srinagar in July 1955. The proposal then appeared revolutionary to some of those participating in the Seminar, but apparently it formed the basis of the River Boards Bill of 1955 and its necessity therefore appears to have been felt by the Central Government. The only difference is that the River Boards Bill envisages the setting-up of purely advisory bodies, whereas we believe that though such bodies may function in the initial stages they will eventually have to be vested with considerable executive power if they are to play a really useful and forceful role in the development of river valley flows.

138. The States Reorganisation Bill now before Parliament also envisages the setting up of Regional Councils to plan the development of groups of States. Such Councils have been felt to be necessary to counteract narrow provincialism and to bind the country together, particularly in the field of planning and economic development, and their concept is thus basically the same as that of the Zonal authorities recommended by us.

139. But even if Zonal Authorities are established, the Ministry of Irrigation and Power would nevertheless need a Central organisation to co-ordinate their work but the functions of such an organisation would be confined largely to advising the Ministry in regard to the settlement of disputes between the Constituent States of the Zones and to the collection of technical and hydrological data, etc.; supplied by the Zonal Authorities and States, and their dissemination throughout the country; affording technical advice or assistance to any State or Development Authority seeking it; and scrutinising zonal projects for the purpose of helping the Planning Commission in determining which should be included in the successive plans and afforded financial assistance by way of loans; reviewing their progress etc.

140. Incidentally, this set-up would have the further advantage of enabling the Centre to indicate proposed allocations of funds on a zonal basis rather than for individual projects as at present. It would also make for real planning, after proper investigation, of zonal development and of each project in the zone, and the present, almost indecent haste with which projects are prepared and submitted *en masse* by the individual States, anxious to stake as big a claim on the central funds as possible, would be a thing of the past.

141. Pending the setting-up of the Zonal Development Authorities advocated above, the present isolated State organisations will of course continue with their limited co-operation with each other for the execution of projects in which they have a common interest. Every encouragement should be held out by the Centre to such Project Authorities or Development Boards as have already been created, for the purpose of executing Projects affecting more than one State, to extend their co-operation to the planning of other projects situated in the same region and affecting the same States. In other cases Development Boards should be set up even if they only function as purely advisory or consultative bodies. It is to be hoped that with the efflux of time the advantages of concerted action in the economic development of river basins will induce the States to vest an increasing measure of executive power in the Boards, until in due course they become the main planning and executive authorities of the regions concerned.

142. The C.W. & P.C. provides a ready-made central organisation such as we envisage and we recommend that it should continue more or less in its present form until the evolution of the Zonal Authorities reaches the point when its function will need to be readjusted to serve them in the manner described.

143. But as the idea of Zonal Development Authorities catches on the C.W. & P.C. should progressively restrict its activity to that of a Brain Trust for the country; but whether it continues to function as it does at present or confines itself in future largely to affording technical advice and assistance as indicated earlier, we would like to emphasise that its scrutiny of projects or its advice on projects, should be appropriate to its level. We have noticed a tendency towards too-detailed scrutiny of projects, which may be justified because of inadequate investigation and preparation of the projects submitted by the States, but this unsatisfactory state of affairs will only be perpetuated if the C.W. & P.C. assumes a responsibility which properly devolves on the States.

144. The Central Board of Irrigation at whose instance the C.W. & P.C. came into being appears to have receded completely into the background. To our mind it can still serve a useful purpose if it were to enlarge its scope and functions to enable it to act as a high-powered consultative body which could not only review irrigation development in the country and enable its members to exchange ideas and experience, but could also discuss the irrigation and power policy of Government, thus affording the Ministry of Irrigation and Power a valuable means of knowing how the country as a whole reacts to its policies and pressures.

145. Another point we would wish to make is that the Control Boards of various projects as at present constituted have been brought into existence mainly to enable the Centre to exercise through one or two representatives a certain measure of financial control over the execution of specific projects. This is not the main aim in our concept of zonal development. Such financial control only serves a limited purpose whereas the development boards envisaged in our proposal are intended to assume much wider responsibilities and exercise much more effective direction and control.

CHAPTER VII

FOREIGN EXPERTS

146. The Prime Minister in a recent address said :—

“I cannot have first-rate projects constructed by second-rate engineers. We cannot afford to be complacent in the slightest in these matters. The question of economy also could not arise here. Economy is good but it should not be at the cost of the quality of the work. If any false economy is made then the result may be disastrous.” He added that “India would go to the ends of the earth to get the best engineers and specialists required for such jobs. In these matters, I am not prepared to tolerate any talk of nationalism. This kind of thing is second-rate nationalism. I do not like this kind of second-rate nationalism. I want only that nationalism in my country which is first-rate. I will be never willing to employ second-rate men for first-rate work in the name of nationalism.”

India is not lacking in first-rate men or men that could be easily made first-rate given proper facilities and encouragement. Indian engineers, we think, possess sufficient technical knowledge to know how far they can go safely and when they should take advice and when they should indent on the superior knowledge of other countries. If our engineering training, particularly at post-graduate levels, is not improved as suggested in an earlier chapter and research is not extended and encouraged in every way, Indian engineers will always remain far behind their American and European confreres and we shall continue to be required to go to the ends of the earth to get the talent we want to carry out our country's ambitious programmes of development.

147. In an earlier chapter we have referred to the circumstances under which foreign consultants have been engaged and foreign executives and technicians have even been employed on actual construction in the country.

148. For the future we recommend the following pattern of association with foreign experts :—

(1) It may be necessary and should not be regarded as objectionable to seek the assistance of foreign consultants occasionally, especially in regard to particularly difficult and complex details of planning or construction. There are special types and techniques of construction developed in other countries of which we have little or no experience in our own. We could of course learn for ourselves by the painful process of trial and error, but where public thinking has yet to advance to the stage when it regards a *bona fide* error with indulgence, we could not do away with foreign consultants altogether. Moreover, such learning would be a long drawn-out process and would always leave us lagging far behind the progressive countries of the world.

(2) The heavy mechanical and electrical plant and equipment used or installed in River-Valley Projects is not yet manufactured in the country. As long as such plant and equipment is imported, the advice of foreign consultants in regard to its setting up and use may be necessary. Even in advanced countries when plant and equipment of specialised type is imported from

other countries, it is usual to import at the same time technicians from the exporting countries to advise the purchasing country on its correct operation and maintenance. It is necessary however to remember that these foreign technicians who come along with their machinery merely erect and operate it. They usually jealously guard as trade secrets all details of the design and even of the civil works necessary for its installation at the site of works.

If the country is to become finally independent in this regard, it must never rest content with following the designs of foreign experts or employing foreign plant and machinery, but must become capable of producing the designs and manufacturing the plant and machinery itself with such modification as are required to suit local conditions. This leads us back to the necessity of academic study and research of the highest quality and range.

In the Second Five-Year Plan special emphasis has rightly been laid on the indigenous manufacture of heavy plant and equipment, but till such time as we produce them in sufficient numbers, technical advice and assistance from abroad may have to be sought.

(3) At the same time we believe that there should be no need in future to recruit foreign executives or technicians for actual employment in the country on the planning or construction of River Valley Projects. In the last eight years Indian engineers have acquired sufficient self-confidence to make the continued employment of foreign experts no longer necessary. Even if the employment of foreign experts is expected to lead to economies in construction costs or to greater speed in the completion of projects—which is doubtful—the losses and gains must be reckoned not only in terms of money or of time; the injury to the self-confidence of our engineers is, we believe, so considerable that it would be worthwhile countenancing some reduction of efficiency or increase in the time taken to get the job done by Indian personnel alone. If a Chief Engineer is given to understand that he is free to consult any other engineer in the country, just as a doctor, even in Government service, does when treating an important patient or when confronted by a complex case, we are confident that our engineers will soon prove equal to any occasion.

(4) One reason for employment of foreign experts in the past has been that we have planned and constructed very large works e.g. dams of stupendous heights, storages of staggering capacities etc. Happily, we have now begun to be content with works of more manageable proportions. This should automatically reduce our dependence on foreign experts.

149. Foreign consultants should, in our opinion, be engaged preferably through some International Organisation such as the U.N.O. or Colombo Plan Authorities or through the agency of the Government of the country to which the consultants belong. This would considerably reduce the risk of our going to the wrong men, as the International Organisation or foreign Government would feel that it has some stake in our Projects.

150. We have referred to the crisis in engineering circles in the country which as we see it, is a crisis arising out of a lack of confidence of our engineers in themselves. This lack of confidence manifests itself in two forms—(a) a lack of self-confidence to make technical decisions, and (b) a lack of confidence in subordinates. While, as we have pointed out in

an earlier chapter, this lack of confidence is due to the "barren period" intervening between the two World Wars it has been perpetuated and aggravated by the deplorable disinterest shown by many engineers, particularly the older ones, in reading up their subject and keeping upto date with the latest developments in the profession.

151. The country has every right to expect engineers with 15-20 year's experience to be able to learn and adapt themselves to the new tools which modern technology has placed in their hands, and to be independent of props while they do so. The impression is growing among not only the younger generation of engineers but also the lay public that there are some people at the top who reached their limit long ago, but have succeeded in extending their service on grounds of doubtful experience and indispensability—claims they are unable to live up to. We cannot allow this state of affairs to continue.



CHAPTER VIII

MISCELLANEOUS

(i) *Re-employment of Superannuated Personnel.*

152. In Chapter III we have seen that one of the steps to be taken to meet the critical shortage of graduate engineers being experienced at present is the retention of persons at all levels for a suitable period beyond the age of superannuation. This remark applies equally to other categories as well, in other words all technical personnel may be retained in service beyond the present age of superannuation either by raising the age suitably or by re-employing all those who have the ability and energy to make their retention useful. It should be noted however that such re-employment has caused considerable discontent in the lower grades and should therefore be resorted to either as a general measure i.e. by raising the age of superannuation for all by a suitable margin, or by making such re-employment absolutely exceptional. In the lower grades and categories less exacting standards may be applied.

(ii) *Panel of Retired Engineers.*

153. There is a considerable reservoir of talent and experience in the country which could, we believe, be tapped as and when required if retired men of proven ability were invited to join panels which could be consulted whenever problems, of which they have had personal experience, arose. Many retired engineers have expressed their willingness to serve their country in this way and we recommend the formation of such panels for advising the State and Central Governments whenever the necessity arises. They could also serve as members of Control Boards or projects.

(iii) *Economic and Statistical Section.*

154. Strange as it may seem it is nevertheless a fact that many State Governments have no satisfactory arrangements for collecting and analysing statistical data relating to irrigation and power projects, their costs and benefits. Both on the design and construction side of projects and on the management side of the irrigation and power systems that they establish, it is essential that proper data should be collected, arranged and incorporated for future guidance. It is only thus that the characteristics of design and their correlation with costs, efficiency and the ensuing benefits can be determined. We would therefore urge that the Irrigation and Power Ministry should have an Economic and Statistical Adviser who would discharge these functions and advise the Ministry on the economic aspect of Irrigation and Power projects. State Governments should establish a proper Statistical Section in the Irrigation and Power Departments with a qualified statistician in charge. This Section will have to be fed by statistical cells established in each project office or area and engineers will have to be associated with the work of collection and interpretation of data at every stage.

(iv) *Liaison with Corps of Army Engineers.*

155. We have explored the possibility of sapper units using heavy earth-moving machinery being employed on irrigation projects. We felt that if the project authorities provided the funds for the purchase of

the machinery and equipment the army might find it profitable to deploy their training units on irrigation and flood protection works where they would gain valuable experience in the handling of the machinery and in large-scale construction, whereas the project authorities on their part would have the services of an organised and disciplined corps of workmen. Though such arrangement appears exceedingly attractive, there are serious difficulties in the way of its implementation, particularly since the plant and machinery would have to be owned by the Corps of Engineers, but paid for by the individual States or Project Authorities. Perhaps with the establishment of Zonal Development Boards, and a larger turnover of plant and machinery and its likely movement from project to project, the chances of such an arrangement to be successful would greatly improve. In the meantime the J.C.Os. and N.C.Os. now being released and placed on the Reserve in fairly large numbers by the three Army Engineer Groups and E.M.E. Corps could, we suggest, be usefully employed as Instructors etc. in the Mechanical and Electrical Assistant Training Centres which we have recommended to be set up (*vide* Chapter III).

(v) *Creation of a Cadre of Surveyors of Works.*

156. With a view to enabling engineer officers to concentrate as far as possible exclusively on technical matters, it is necessary to relieve them of the enormous amount of hack work involved in the preparation of estimates, tender documents and preparation of bills of quantities etc. In the M.E.S. and also to some extent in the Central Public Works Department this work is entrusted to a special cadre of Surveyors of Works, and we think that a similar cadre might be instituted in the Irrigation and Power Departments of the various State Governments. The cadre need not be a totally distinct cadre from the engineering cadre, but members of the latter should be seconded for a period of years to the Surveyor of Works cadre, but this period should be sufficiently long to enable the benefits of specialisation to accrue to work of the Officers, say 5 years. Further preparation of bills for payment, settlement of Contractors' claims etc. need not be entrusted to the Surveyors of Works as in the M.E.S., since it merely results in duplication of work—first by the Engineers in the field and then by the Surveyors.

(vi) *Creation of a Cadre of Technical Examiners.*

157. As Mr. Paul Appleby has pointed out most of our projects receive far too much attention and scrutiny before they are sanctioned and far too little after they are taken in hand and completed. It is necessary, in our opinion, that there should be some agency to evaluate the results not only as regards the benefits resulting or accruing from the projects, but also as regards details of construction. This evaluation should, in our opinion, be carried out by an independent body of men who are subject only to the authority of the Chief Engineer. They should visit works and report whether specifications have been complied with and if they have, whether they were in any way wasteful or defective. In the M.E.S. the Chief Technical Examiner and his subordinates perform this function on behalf of the Quarter-Master General, whose watch-dogs they are. They are totally independent of the Engineer-in-Chief and his subordinates, but this, to our mind, is liable to lead to considerable friction between the two sets of men and we therefore consider that the Technical Examiner in the case

of irrigation and power projects should be of the rank of Superintending Engineer, with a complete set of subordinate officers as required, but this Technical Examiner should be directly subject to the Chief Engineer of the Project.

(vii) *Introduction of Technical Personnel in General Administrative Machinery.*

158. We have quoted at considerable length the Prime Minister's views in regard to the importance of engineers and scientists in the context of the country's enormous developmental programmes and the necessity for their being associated more and more with the various governmental processes, including administration and planning. We are not aware that any State Government or, for the matter of that, the Central Government itself has made the smallest move to ensure such association in administration—except in the lower rungs of the Public Works Department hierarchy in some States and of the Ministries of Irrigation and Power and of Works at the Centre—though there is some evidence of it in connection with central planning. The Engineering Personnel Committee has also commented on the greater need for diversification in administration and recommended that technical and scientific personnel should be introduced at suitable levels in the general administrative machinery, specially to hold posts where their experience is of value, as for example in the Industries and Development Department of the States and the Centre. The second Appleby Report also has pointed out how difficult it is for the pure administrator to provide "administrative leadership having knowledge of its business" as he has to move from assignment to assignment far too often.

159. There is a universal demand for new thinking in the sphere of government and administration but the old thinking still determines the administrative patterns, particularly in the States. To attract some of the best talent to the technical cadres of the country, Government should boldly announce a new charter for engineers under which they should be appointed to secretariat posts in government administration, including that of Secretary to Government, managerial posts in public corporations, chairmanships of Port Trusts, Improvement Trusts etc., in short all those posts which can, with advantage, be held by persons with a technical background. In other words, engineers should be free to aspire to fill the highest posts in the country's service and not be restricted, as at present, to their own strictly professional field for preferment in office.

- (Sd.) W. X. Mascarenhas.
- (Sd.) G. K. Chandiramani.
- (Sd.) B. N. Datar.
- (Sd.) R. S. Basrur.
- (Sd.) N. S. Gupchup.
- (Sd.) J. V. P. Braganza.
- (Sd.) A. K. Char.
- (Sd.) Ripudaman Singh.

NEW DELHI,
Dated 8th September, 1956. }

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

(Figures in brackets refer to paragraph numbers)

1. In the vast majority of cases, the country's demands could be more conveniently and economically met by a large number of medium-sized projects than a small number of gigantic size. (11).

2. Mobility of the various categories of personnel required for river valley projects excepting graduate engineers is generally speaking limited. (25 to 27).

3. In assessing the demands for technical personnel, the following assumptions have been made :—

- (a) The personnel employed were upto requirements at the time of collection of data.
- (b) Employment pattern will remain substantially the same in future projects.
- (c) The expenditure on Irrigation and Power projects will be of the order of Rs. 1300 crores in the Third Plan and Rs. 1650 crores in the Fourth Plan. (31 & 32).

4. The high demand in 1956-57 cannot be met through the normal methods of training. Special short-term measures must, therefore, be resorted to as follows :—

- (i) judicious promotion from lower ranks;
- (ii) more balanced utilisation of available talent;
- (iii) retention of persons for suitable periods beyond the age of superannuation;
- (iv) temporary overloading of the existing staff where this is not already being practised;
- (v) organization of functional training at the supervisory levels. (35 to 42).

5. It is undesirable and wasteful for graduates to hold overseers' posts except possibly in very rare cases and for a brief period at the commencement of their careers. (44).

6. To meet partially the large demand of overseers short-term functional training should be organised for 'Technical Assistants'. (49).

7. It will be necessary to turn out about 2200 technical Assistants (Civil) and 550 Technical Assistants (Electrical and Mechanical) per year for the two years 1957-58 and 1958-59. (50).

8. The new category of Technical Assistants may be continued on a permanent basis in partial replacement of diploma-holders if the experience justifies it. (51).

9. Technical Assistants should be trained at the rate of 400 Civil and 250 Mechanical & Electrical per year during the years 1959-60 and 1960-61. During the Third Five-Year Plan period (1961-66), 400 Civils and 250 Mechanicals & Electricals per year would require to be trained. (55).

10. Training facilities for Mechanical and Electrical Assistants must be very widespread. Training centres should be set up at the project headquarters or near the sites of works. (57).

11. Operators for various types of machinery should be trained by arrangements with the suppliers of such machinery. (61).

12. Completion of the broad-based courses covering fundamentals of engineering sciences provides only a satisfactory starting point for subsequent specialisation. (63).

13. Much time is devoted in colleges to the teaching of professional details, which can be picked up after graduation. (66).

14. A uniform duration of 4 years for courses leading to an engineering degree recommended by the Joint Committee of the All-India Council for Technical Education and the Inter-University Board should be adopted. (67).

15. For post-graduate degrees, the courses should aim at depth rather than breadth. (68).

16. Government should offer financial assistance to enable the colleges to provide adequate accommodation and equipment and staff. (69).

17. To raise the standard of technical education, Government should loan the services of experienced officers to serve as teachers in engineering colleges, particularly in the fields of irrigation and power engineering, where experience is almost exclusively restricted to Government engineers. (69).

18. Private colleges employ as few men on their staff as they can possibly get away with. Government should insist that no technical institution will qualify for grant-in-aid unless it maintains a certain minimum ratio of teachers to the taught. (74).

19. A professor in an engineering college should draw the same salary as a Superintending Engineer; a Lecturer the same as an Executive Engineer; and Assistant Lecturer the same as an Assistant Engineer and should draw a special pay of Rs. 150 p.m. in addition. The Principal should draw a special pay of Rs. 250 p.m. in addition. (75).

20. Specialised academic training in irrigation and power engineering for under-graduates is not feasible and in fact undesirable. (76 to 78).

21. More time and attention should be devoted to the study of Social Sciences, Industrial Psychology and Labour Relations etc. in the under-graduate engineering courses. (79).

22. Even though assessment of requirements calls for expansion of training facilities, quality of teaching must not be allowed to suffer on that account. (80).

23. Recruitment to gazetted State Services should be on the basis of competitive examinations. (82).

24. The two cadres for irrigation and roads and buildings should be separated and there must be specialisation and research within the cadres. (83).

25. An All-India Service of Irrigation and Power Engineers should be created. This Service should enjoy the same status, pay-scales and conditions of service as other All-India Services. This will ensure continuity of policy and will enable its members to exhibit greater independence of technical opinion. (84 to 86).

26. An engineer's training is not completed when he leaves the portals of his college. He must acquire practical and drawing office experience for at least two or three years before he can be entrusted with responsible work. (87).

27. The recruit should be trained by Officers who are truly interested and sympathetic and can offer counsel and guidance not only in professional matters but also in departmental etiquette, public relations etc. A course of about two months duration in accounts and procedure should be organised at regular intervals and Officers of all grades and even subordinates should be required to take this course. (87 & 88).

28. Officers should be encouraged to take post-graduate courses and to specialise in particular fields. (89).

29. All engineers should be required to take refresher courses at periodical intervals, say every 5 or 7 years and these courses should be organised either in the individual States or on an inter-State basis or even by the Central Government. (89 & 90).

30. Officers should have the benefit of both theoretical and practical knowledge in and through selected Universities in Europe and America. For this purpose special scholarships should be offered and the study-leave rules liberalised. (92).

31. Visits to important works at home and abroad should be permitted freely and the expense borne in whole or in part by the State depending on the merits of the individual cases. (93).

32. Seminars and conferences should be held once in two years and attended by only selected persons, the subjects discussed being strictly limited. (95 & 96).

33. A Staff College should be established for the study of socio-economic, administrative and practical aspects of planning and execution of big projects. (97 to 99).

34. Separate cadres of Irrigation Engineers and Power Engineers which exist in most of the major States should be instituted in all the remaining States. There should be specialisation within the respective cadres also. (101 & 102).

35. The Public Works Department structure, fashioned as it was in the latter half of the 19th century, is incapable of meeting the needs of today (103).

36. The basic feature of Public Works Department Organisation viz. territorial charges should now be restricted purely to maintenance and operation of works and all planning and construction of major works should be organised on a functional or specialist basis. Functional basis for planning and construction can only be feasible with the creation of specialist cadres and sub-cadres. (103).

37. Every State should have a Research Station of its own. (104).

38. Specialist Officers and Research Officers should be paid adequate allowances and the benefit of the 'next-below-rule' should be allowed in their case. (104).

39. The Hydro-Dynamical Research Station at Khadakwasla should be constituted into a National Laboratory on a par with the other National Laboratories in the country; it should confine itself to purely hydro-dynamical problems. Other work should be carried out only in an ancillary capacity. (105).

40. The limits of authority and responsibility of every Officer should be clearly defined and there should be no interference within those limits. (107).

41. Until recently Chief Engineers also functioned as Secretaries to Government in most of the old Provinces and States; but since 1949 the general policy of State Governments has been to separate the duties of the two posts and to appoint a member of the civil or administrative service as Secretary. (108 & 109).

42. The magnitude and complexity of modern engineering projects is such that it is impossible for a mere administrator even to grasp all their implications or understand their true significance and this fact has been recognised by the Prime Minister himself. (112).

43. The best arrangement would be to make the Chief Engineers Secretaries to Government but where the technical works-load is too heavy the Secretary may be another senior, though not necessarily the senior-most engineer. (113 to 115).

44. The correct relationship between the Secretariat and the Head of the Department viz. the Chief Engineer should be clearly understood and enforced as mentioned in the Gorwala Report. (115).

45. The friction between engineers and administrators, specially Officers of the Revenue Department, at District and Divisional levels, must be eliminated by a clear recognition by the administrators that co-ordination does not mean subordination. (117).

46. The engineer is required to fill a crucial role in the Five-Year Plans of the country, and his importance must be recognised by affording him the same pay-scales, service conditions and status as are enjoyed by the members of the I.A.S. (118 to 122).

47. The present administrative and technical powers exercised by Officers should be substantially enhanced. The posting of all staff should be the responsibility of the Departmental Head whose advice the Ministry should always accept except in very special circumstances. (123 to 127)

48. The Committee's assessment of technical personnel requirements for river valley projects is based on the assumption that it is possible to equate surpluses in any one area with deficits in other areas, after allowing for certain transference losses due to the immobility in varying degrees of various categories of technical personnel and that there is a phased and continuous movement of various men of technical talent and experience from project to project as required. (128).

49. Our first need is therefore to build up planning and construction organisation for river-valley projects on a comprehensive and rational basis. (128).

50. Zonal Development Organisations each covering one or more complete river basins as far as possible are the best solution in the existing circumstances. (129 to 138).

51. A Central Organisation to co-ordinate the work of the Zonal Authorities would be necessary and the Central Water and Power Commission could fill this role. (139 to 142).

52. As the idea of Zonal Development Authorities develops the Central Water and Power Commission should progressively restrict its activity to that of a "Brain Trust" for the country. (143).

53. The Central Board of Irrigation should act as a high power consultative body which could not only review irrigation development in the country but also discuss the irrigation & power policies of Government. (144).

54. Engineering training, particularly at post-graduate levels, should be re-organised and improved and research work extended and encouraged in every way so that Indian Engineers should possess the required talent to carry out the country's ambitious programme of development. (146).

55. The Committee do not see any objection in seeking assistance of foreign consultants occasionally, especially in regard to particularly difficult and complex details of Planning and construction. [148 (1)].

56. For so long as we do not produce heavy electrical and mechanical plant and equipment in this country and such equipment is imported, the advice of foreign consultants in regard to its use may be necessary. [148 (2)].

57. There should be no need in future to recruit foreign executives or technicians for actual employment in this country. [148 (3)].

58. Foreign consultants should be engaged through some international organisation, or through the agency of the Government of the country to which the consultants belong. (149).

59. Either the age of superannuation should be raised as a general measure for all by a suitable margin or re-employment made absolutely exceptional. (152).

60. Retired engineers of proven ability should be invited to join panels which could be consulted whenever problems of which they have had personal experience arise. (153).

61. Every State Government should establish a proper Statistical Section for collecting and analysing statistical data relating to irrigation and power projects. (154).

62. Released army personnel may be employed as Instructors in Training Centres in the use and maintenance of heavy earth-moving machinery. (155).

63. A cadre of Surveyors of Works may be created with a view to enabling engineering Officers to concentrate as far as possible exclusively on technical matters. (156).

64. An independent agency should be set up at large projects for ensuring that specifications are complied with, particularly on works that are executed departmentally. (157).

65. Government should boldly announce a new charter for engineers under which they should be appointed to secretariat posts in Government administration, including that of Secretary to Government, managerial posts in public corporations, chairmanship of Port Trusts, Improvement Trusts etc., in short all those posts which can, with advantage, be held by persons with a technical background. In other words, engineers should be free to aspire to fill the highest posts in the country's service and not be restricted, as at present, to their own strictly professional field for preferment in Office. (158 & 159).




APPENDIX I
PROFORMAE



GOVERNMENT OF INDIA
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE
River Valley Projects Under Execution
Yearly Expenditure on Works and Establishment

PROFORMA I

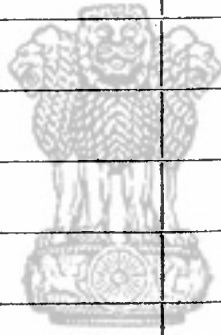
(N. B.—A separate proforma should be filled in, in respect of each project.)

I. Name of Project and Total Cost.		Remarks
II. Nature and Scope of Project— 1. Total Storage in m. cft. or Acre ft. . . . 2. Irrigable Area— (i) Cultivable commanded area (ii) Area Actually Irrigated— Perennial Kharif Rabi 3. Power Generated (Installed Capacity)		 सत्यमेव जयते
III. Period of Completion of Project— Year of commencement and year of completion		
IV. Qualities and cost of Civil Works. (Amount of expenditure incurred or proposed to be incurred each year during the currency of the Project should be stated separately). (The labour cost may be given separately in the remarks column as percentage of total cost under the sub-head).		

Volume of Work and Expenditure Year by Year

[illegible]

(i) Weir Proper of Canal Head .	
(a) Excavation for founds etc.	
(b) Concrete	
(c) Masonry	
(d) Earthwork	
(e) Special measures e.g. grouting, etc.	
(ii) Spill-way Gates, Sluices, etc.	
(iii) Flood Embankments (earthwork)	
3. Canals—	
(i) Earthwork	
(ii) Lining Canals	
(iii) Masonry Works	
4. Sub-soil Drainage Works	
V. Quantities and Cost of Power Generation and Transmission	
1. Tunnels—	
(i) Length and volume of cutting.	
(ii) Lining to Tunnels	
2. Hydel-Channels—	
(i) Length and volume of cutting.	
(ii) Lining to channels	
3. Conduits—Length and size.	
4. Forebay—Storage in m. cft.	



सत्यमेव जयते

Volume of Work and Expenditure Year by Year

[illegible]

	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.
VII. Cost of Planning and Construction Staff**												
(a) Surveying and Planning Staff												
(b) Construction Staff												
(c) Work-charged Establishment (not already allowed for in Works Expenditure under IV and V above												

	Civil Works			Power Installations			Remarks
	Strength	Likely expenditure per year	Strength	Likely expenditure per year	Strength	Likely expenditure per year	
VIII. Operational Staff (to be employed on completion of Project).							
As per categories given in Proforma II and Appendix 'A'							

*Cost of (a) Plant and equipment, and (b) erection and installation should be separately stated.

**Where works or parts of works are executed by contractor, expenditure on staff employed should be ascertained from the contractor or otherwise.

Only regular Technical Engineering Staff is to be included in (a) and (b) and work-charged staff in (c).

Signature_____

Designation_____

**GOVERNMENT
RIVER VALLEY PROJECTS TECHNICAL**

River Valley Projects


Details of Staff

- (N.B.—1. A separate proforma should be filled in,
2. The categories given below are only

1. Name of Project.
2. Details of Staff : (a) No. required. (b) No. actually employed.

Personnel	Surveying & Planning					
	Permanent			Temporary		
	Civil	Mech.	Elec.	Civil	Mech.	Elec.
	a b c	a b c	a b c	a b c	a b c	a b c
C. E.						
S. E.						
E. E.						
A.E./Dy. Engr.						
Subordinates i/c Sub-Divn.						
Overseer & equivalent.						
Sub-Overseer.						
Head Draftsman.						
Draftsman.						
Storekeeper.						
Specialist Officers Research & Testing.						

Personnel						
	Surveying & Planning					
	Permanent			Temporary		
	Civil	Mech.	Elec.	Civil	Mech.	Elec.
	a b c	a b c	a b c	a b c	a b c	a b c
C. E.						
S. E.						
E. E.						
A. E./Dy. Engr.						
Subordinates i/c Sub-Divn.						
Overseer & equivalent.						
Sub-Overseer.						
Head Draftsman.						
Draftsman.						
Storekeeper.						
Specialist Officers Research & Testing.						

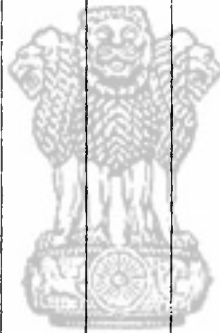


सत्यमेव जयते

Personnel	Surveying & Planning					
	Permanent			Temporary		
	Civil	Mech.	Elec.	Civil	Mech.	Elec.
	a b c	a b c	a b c	a b c	a b c	a b c
C. E.						
S. E.						
E. E.						
A.E./Dy. Engr.						
Subordinates i/c Sub-Divn.						
Overseer & equivalent.						
Sub-Overseer.						
Head Draftsman.						
Draftsman.						
Storekeeper.						
Specialist Officers Research & Testing.						

PROFORMA II—Contd.

Construction						Work-charged establishment not allowed for in works expenditure in IV and V of Proforma I	Remarks		
Permanent			Temporary						
Civil a b c	Mech. a b c	Elec. a b c	Civil a b c	Mech. a b c	Elec. a b c			Civil a b c	Mech. a b c




सत्यमेव जयते

Personnel	Surveying & Planning					
	Permanent			Temporary		
	Civil	Mech.	Elec.	Civil	Mech.	Elec.
	a b c	a b c	a b c	a b c	a b c	a b c
C. E.						
S. E.						
E. E.						
A.E./Dy. Engr.						
Subordinates i/c Sub-Divn.						
Overseer & equivalent.						
Sub-Overseer						
Head Draftsman.						
Draftsman.						
Storekeeper.						
Specialist Officers Research & Testing.						

[illegible]

Personnel						
	Surveying & Planning					
	Permanent			Temporary		
	Civil	Mech.	Elec.	Civil	Mech.	Elec.
	a b c	a b c	a b c	a b c	a b c	a b c
C. E.						
S. E.						
E. E.						
A. E./Dy.						
Subordinates 1/c Sub-Divn.						
Overseer & equivalent.*						
Sub-Overseer.						
Head Draftsman.						
Draftsman.						
Storekeeper.						
Specialist Officers Research & Testing.						



सत्यमेव जयते

Designation _____

GOVERNMENT OF INDIA
MINISTRY OF IRRIGATION AND POWER
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE

PROFORMA II-A

River Valley Project under execution

Accounts Personnel employed or anticipated during various years

(N. B.—1. A separate proforma should be filled in, in respect of each project.

2. If the No. of columns for years are not sufficient another proforma may be used in continuation.)
(a) No. required. (b) Actually engaged.

Name of Project and Total Cost.

Sl. No.	Personnel Grade (As well as equivalent Grade)	Surveying, Planning and Construction.											
		19						19					
		Surveying & Planning			Construction			Surveying & Planning			Construction		
		Perm.	Temp.	a b	Excluding cost Accounting	Perm.	Temp.	a b	Excluding cost Accounting	Perm.	Temp.	a b	Cost Accounting Perm. Temp. a b
1.	Assistant Accounts Officer with at least 5 years experience as Divisional Accountant.	a	b	a b	a b a b	a	b	a b	a b a b	a	b	a b	a b a b
2.	S. A. S. Accountants with at least 5 years experience as Divisional Accountant.												
3.	I. Qualified with more than 5 years experience. II. Qualified but less than 5 years experience.												
4.	U.D.Cs. with 5 years experience of Public Works Accounts.												
5.	L.D.Cs. with 2 years experience of Public Works Accounts.												
Total Cost of Personnel													
Total Cost Above													

PROFORMA II-A—Contd.

Surveying, Planning and Construction																Operation after Completion	REMARKS		
Sl. No.	Personnel Grade (as well as equivalent Grade)	19						19											
		Surveying & Planning			Co nstruction			Surveying & Planning			Excluding cost Accounting			Construction					
		Perm.	Temp.	a b	Excludin Cost Accounting	Perm.	Temp.	a b	Perm.	Temp.	a b	Perm.	Temp.	a b	Perm.			Temp.	a b
1.	Assistant Accounts Officer with at least 5 years experience as Divisional Accountant.	a	b	a b	Perm.	Temp.	a b	Perm.	Temp.	a b	Perm.	Temp.	a b	Perm.	Temp.	a b	Perm.	Temp.	a b
2.	S. A. S. Accountants with at least 5 years experience as Divisional Accountant.																		
3.	Divisional Accountants.— I. Qualified with more than 5 years experience. II. Qualified but less than 5 years experience.																		
4.	U.D.Cs. with 5 years experience of Public Works Accounts.																		
5.	L.D.Cs. with 2 years experience of Public Works Accounts.																		
Total Cost of Above Personnel																			

Signature

Designation

GOVERNMENT OF INDIA
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE
River Valley Project Under Execution

Technical Personnel (Operational & Maintenance) and Semi-skilled Labour engaged Year by Years.

(This proforma is to be filled in for the various years the project was under execution, one proforma for each year)

Working Season :—From.....to.....

Non-Working Season :-From.....to.....

[illegible]

GOVERNMENT OF INDIA
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE
PROFORMA IV

River Valley Projects Under Execution

Details of Special Tools and Plant on the Project and the Operational Staff employed on it.

(N. B.—A separate proforma should be filled in, in respect of each Project)

1. Name of Project _____

2. Cost of Special Tools and Plant _____

Year ending _____

Name of Plant	(a) Those whose cost is reflected in works expenditure. (*See foot note)				(b) Those whose cost is not reflected in Works Expenditure (*See foot note)				(c) Operational per shift		No. of shifts	Remarks	
	Units		Total original value	Total cost of erection and installation	Total cost of spares	Units		Total original value	Total cost of erection and installation	Total cost of spares			
	No.	Capacity				No.	Capacity						
	2	3	4	5	6	7	8	9	10	11	12		13	14
1													
1. Quarrying Plant : (i) Compressors (ii) Pneumatic Drills. (iii) Pneumatic Hammers. (iv) Loading Plant e. g. Shovels, elevators etc.													
2. Crushing or Processing Plant : (i) Crushers. (ii) Screens. (iii) Conveyors.													
3. Cement Storage : (i) Silos. (ii) Pumps													

*Where only part cost of certain machinery is reflected in works expenditure, only that part may be shown in (a) and the balance under 'b). In such cases, the cost of erection and installation may be shown under (a) only.

[illegible]

4. Transport Plant for stone aggregate, cement:
 - (i) Conveyors.
 - (ii) Dumpers.
 - (iii) Motor Trucks.
 - (iv) Rope-Ways.
5. Stored-silage recovery plant.
6. Cooling Plant.
7. Batching and Mixing plant.
8. Concrete Carrying Plant:
 - (i) Locos. etc.
 - (ii) Wagons,
 - (iii) Buckets,
 - (iv) Miscellaneous.
9. Concrete Depositing Plant :
 - (i) Cranes.
 - (ii) Trolleys
 - (iii) Cableway.
 - (iv) Concrete Pump.
10. Consolidation Plant:
 - (i) Vibrators
 - (ii) Compressed air equipment
 - (iii) Miscellaneous

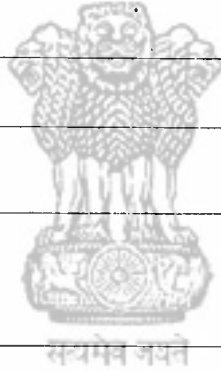
11. Earthmoving Plant:

- (i) Shovels.
- (ii) Dumpers.
- (iii) Loaders.
- (iv) Trailers (Haulage equipment).
- (v) Scrapers.
- (vi) Graders.
- (vii) Tractors.
- (viii) Sheepfoot-rollers.
- (ix) Draglines.

12. Drilling and grouting plant.

13. Mortar mixers.

14. Electric power installed for construction.




Signature_____

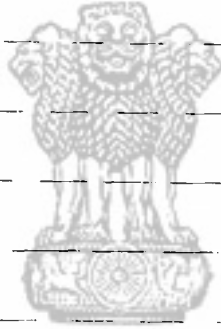
Designation_____

PROFORMA V

GOVERNMENT OF INDIA
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE
River Valley Projects to be undertaken during the 2nd Five Year Plan 1956—61
(N. B.—A separate proforma should be filled in, in respect of each project)

<p>I. Name of Project and Total Cost:</p> <p>II. Nature and Scope of Project.</p> <p>1. Total Storage in, m. cft. or acre ft.</p> <p>2. Irrigable area —</p> <p>(i) Culturable commanded area.</p> <p>(ii) Area to be actually irrigated.</p> <p>Perennial.</p> <p>Kharif.</p> <p>Rabi.</p> <p>3. Power generated (Installed Capacity).</p>	 सत्यमेव जयते	REMARKS
<p>III. Period of completion of Project.</p> <p>Year of commencement and year of completion.</p>		
<p>IV. Quantities and Cost of Civil Works. (Amount of expenditure incurred or proposed to be incurred each year during the currency of the Project should be stated separately).</p> <p>(The labour cost may be given separately in the remarks column as percentage of total cost under the sub-head)</p>		

Power House, including Tail-race Channel.																																
(i) Excavation.																																
(ii) Concrete/Masonry.																																
(iii) Surpass structure																																
7. Generating Plants, including Turbines, (Installed capacity & No. of individual units. *																																
8. Switchgear.*																																
9. Transmission Lines with Transmission voltage and Length of Lines.*																																
VI. Cost of Special Tools and Plant not already allowed for in Works Expenditure Under IV and V above.*																																



सत्यमेव जयते

PROFORMA V—Contd.

86

VII. Cost of Planning & Construction Staff.** (a) Surveying and Planning Staff. (b) Construction Staff. (c) Work-charged Establishment (not already allowed for in works Expenditure under IV and V above.)	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.	Dep.	Cont.	REMARKS
	Civil Works		Power Installations								
	Strength	Likely expenditure per year	Strength	Likely expenditure per year							
VII. Operational Staff (to be employed on completion of Project). At per categories given in proforma II. and appendix 'A.'											

*Cost at (a) Plant and equipment and (b) erection and installation should be separately stated.
 **Where Works or parts of Works are executed by contractor, expenditure on staff employed on such works should be ascertained from the contractor or otherwise.
 Only regular Technical Engineering Staff is to be included in (a) and work-charged staff in (c).

Signature _____
 Designation _____

MINISTRY OF IRRIGATION & POWER

RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE

River Valley Projects to be undertaken during the Second Five-Year Plan 1956-61.

Requirements of Accounts Personnel

Government of _____

Ministry/Department

Corporation/Authority/Project

Sl. No.	Name of Project	Total Cost	Cost of Accounts Personnel required for Surveying, Planning & Construction														
			1956-57			1957-58			1958-59			1959-60			1960-61		
			Surveying and Planning	Construction excluding cost accounting	Cost accounting	Surveying and Planning	Construction excluding cost accounting	Cost accounting	Surveying and Planning	Construction excluding cost accounting	Cost accounting	Surveying and Planning	Construction excluding cost accounting	Cost accounting			

PROFORMA V-A—Contd.

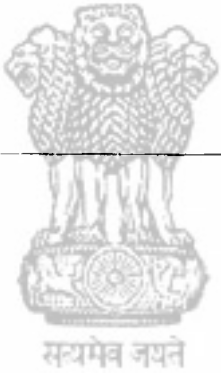
Sl. No.	Name of Project	Account staff required for Operation after Completion	REMARKS
		<div data-bbox="354 1188 611 1304">Assistant Accounts Officer with 5 years experience as Divisional Accountants</div> <div data-bbox="354 1072 611 1188">S. A. S. Accountants with at least 5 years experience as Divisional Accountant</div> <div data-bbox="354 975 611 1072">Divisional Accountants qualified with more than 5 years experience</div> <div data-bbox="354 879 611 975">Divisional Accountants qualified but less than 5 years experience</div> <div data-bbox="354 782 611 879">U.D. Cs. with 5 years experience of Public Works Accounts</div> <div data-bbox="354 666 611 782">L. D. Cs. with 2 years experience of Public Works Accounts</div>	

Signature

Designation

GOVERNMENT OF INDIA
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE
PROFORMA VI
River Valley Projects to be undertaken during the 3rd (1961-66) and 4th (1966-71) Five-Year Plans

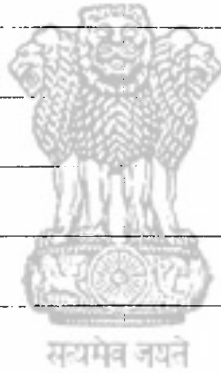
(N. B.—Details of various columns may be supplied to the extent possible. This information may also be supplied for the spill-overs from one Plan to the following Plan.)

I. Name of Project and Total Cost:		REMARKS
II. Nature and Scope of Project. 1. Total storage in m. cft. or acre ft. 2. Irrigable area— (i) Culturable commanded area. (ii) Area to be actually irrigated: Perennial. Kharif. Rabi. 3. Power generated (Installed Capacity).		
III. Period of completion of Project. Year of commencement and year of completion.		
IV. Quantities and cost of Civil Works. (Amount of expenditure incurred or proposed to be incurred each year during the currency of the Project should be stated separately). (The labour cost may be given separately in the remarks column as percentage of total cost under the sub-head.)		

- (d) Earthwork.
- (e) Special measures,
e.g. grouting, etc.
- (ii) Spill-way Gates, Sluices, etc.
- (iii) Flood Embankments
(Earthwork).
- 3. Canals—
 - (i) Earthwork.
 - (ii) Lining Canals.
 - (iii) Masonry Works.
- 4. Sub-soil Drainage Works.

V. Quantities and Cost of Power Generation and Transmission.

1. Tunnels—
 - (i) Length and volume of cutting.
 - (ii) Lining to Tunnels.
2. Hydel-Channels—
 - (i) Length and volume of cutting.
 - (ii) Lining to channels.
3. Conduits—Length and size.
4. Forebay—Storage in m. cft.
5. Penstocks, including Surge
pipes—Length and size.



Volume of Work and Expenditure Year by Year		PROFORMA VI—Contd.									
	Total Quantity	Total Cost	19		19		19		19		REMARKS
			Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	
6. Power House, including Tail-race Channel— (i) Excavation. (ii) Concrete/Masonry. (iii) Superstructure.											
7. Generating Plant, including Turbines, (Installed capacity & No. of individual units)*											
8. Switchgear.*											
9. Transmission Lines, with Transmission voltage and Length of Lines.*											
VI. Cost of Special Tools and plant not already allowed for in Works Expenditure under IV and V above.*									Expenditure year by year		

GOVERNMENT OF INDIA
PROFORMA VII
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE
Technical Personnel engaged on Irrigation and Power Projects and Flood Control Works

Government of.....

Ministry/Department.

Corporation/Authority.

N. B.—The personnel are classed as A—Civil, B—Mechanical, C—Electrical,

Sl. No.	Post or Equivalent Grade	Strength as on 1-4-1954 Engaged on general Irrigation Management on running canals			Strength as on 1-4-1954 Engaged on Irrigation Construction			Strength as on 1-4-1954 Engaged on Investigation, design & construction or maintenance of Special Irrigation Valley Projects			Remarks
		Permanent	Temp.	Contract	Perm.	Temp.	Contract	Perm.	Temp.	Contract	
1	2	3	3-A	3-B	4	4-A	4-B	5	5-A	5-B	6
1	I.S.E. or Class I Chief Engineer										
2	Supdt. Engineer										
3	Ex. Engr.										
4	Asst. Engr.										

7-1 I & P/56

[illegible]

GOVERNMENT OF INDIA
MINISTRY OF IRRIGATION AND POWER
RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE •
Existing Accounts Personnel employed on River Valley Projects and Personnel which can be spared from
Accounts Office to be set up for the Projects

PROFORMA VII-A

Name of State Govt.

		Total Strength employed on River Valley Projects on 1-4-1954								Remarks
Serial number	Grade (as well as equivalent Grade)	Engaged on running, maintenance and management of Irrigation and Power Works		Engaged on Irrigation and Power Construction Works		Engaged on investigation, design, Construction and maintenance of Special River Valley Projects		Permanent	Temporary	
		Permanent	Temporary	Permanent	Temporary	Permanent	Temporary			
1	2	3	4	5	6	7	8		9	
1	Assistant Accounts Officer— (a) with at least 5 years experience as Divisional Accountant (b) with less than 5 years experience as Divisional Accountant									
2	S. A. S. Accountants — (a) with at least 5 years experience as Divisional Accountant (b) with less than 5 years experience as Divisional Accountant									
3	Divisional Accountants— I. Qualified with more than 5 years experience II. Qualified but with less than 5 years experience									
4	Upper Division Clerks— (a) with 5 years experience of Public Works Accounts (b) with less than 5 years experience of P. W. Accounts									
5	Lower Division Clerks— (a) with 2 years experience of Public Works Accounts (b) with less than 2 years experience of Public Works Accounts									

PROFORMA VII-A—contd.

Serial number	Grade (as well as equivalent Grade)	Extent to which can be spared for Accounts Offices to be set up for the Project year by year					Remarks
		1955-56	1956-57	1957-58	1958-59	1959-60	1960-61
1	Assistant Account Officer— (a) with at least 5 years experience as Divisional Accountant (b) with less than 5 years experience as Divisional Accountant						
2	S. A. S. Accountants— (a) with at least 5 years experience as Divisional Accountant (b) with less than 5 years experience as Divisional Accountant						
3	Divisional Accountants— I. Qualified with more than 5 years experience II. Qualified but with less than 5 years experience						
4	Upper Division Clerks— (a) with 5 years experience of Public Works Accounts (b) with less than 5 years experience of Public Works Accounts						
5	Lower Division Clerks— (a) with 2 years experience of Public Works Accounts (b) with less than 2 years experience of Public Works Accounts						

Signature_____

Designation_____

PROFORMA VIII

GOVERNMENT OF INDIA

RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE

Details of Operational and Maintenance Staff and semi-skilled labour employed on Irrigation and Power Projects and Flood Control works

Government of _____

Sl. No.	Post or Equivalent Grade	Strength on 1-4-54 engaged on running and maintenance of Irrigation and Power works	Strength on 1-4-54 engaged on Irrigation and Power construction works	Strength as on 1-4-54 engaged on investigation, design and construction or maintenance of special River Valley Projects	Remarks
---------	--------------------------	---	---	---	---------

1	2	3	4	5	6
---	---	---	---	---	---

Categories as per Appendix "A"

Signature _____

Designation _____

PROFORMA IX

GOVERNMENT OF INDIA

RIVER VALLEY PROJECTS TECHNICAL PERSONNEL COMMITTEE

Details of Qualifications, Experience etc., of Irrigation and Power Engineers and other Specialists with Irrigation and Power Projects

State—
where serving :

Project or Work :

Branch with specialisation if any :—

Civil _____

Mechanical _____

Electrical _____

1. Name in Full
(Block Letters)
 2. Address—
 (a) Present :
 (Place of work)
 (b) Permanent.

PROFORMA IX—Contd.

3. Date of Birth

4. Technical qualifications	Academic	Degrees*	Date	University
-----------------------------	----------	----------	------	------------

5. Membership of Recognised Professional Institutions

6. Present Post :

- (a) Designation.
 - (b) Pay and its scale.
 - (c) Date of joining present post.
 - (d) Nature of post—permanent, temporary or contract.
Type of work engaged on.
 - (d)(i) If contract—period of contract.
-

7. Brief Details of Experience.

8. List of a professional publications.

9. Any other relevant information not included above.

Date.....

Signature.....

NOTE.—Please attach a separate sheet wherever space allotted for any answer is not sufficient.




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Sl. No.	Name of State	Up to 1920	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32	32-33
"A" STATES															
1	Andhra	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	Assam	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	Bihar	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	Bombay	..	..	..	..	..	30-63	26-11	15-4	10-88	10-99	11-14	9-1	6-94	4
5	Madhya Pradesh (Central Provinces)	..	15	7	14	7	6	..	21	18	18	14	80	3-1	1
6	Madras (Andhra) i. e. complete Madras	..	..	..	..	..	..	29-46	17-7	108-7	121	104-6	102-5	109-7	84
7	Orissa	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	Punjab	..	91	174	86	141	151	142	118	59	44	40	11	42	..
9	Uttar Pradesh	..	..	..	..	..	124-75	128-06	139-33	153-96	168-51	143-72	76-78	..	31
10	West Bengal (Projects only) DVC not included	..	..	..	..	..	..	4	16	21	22	21	13	9	3
"B" STATES															
11	Hyderabad (Major Projects only without maintenance)	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Hyderabad including maintenance	..	17-86	20-75	25-78	51-27	56-5	67-1	76-68	70-97	68-8	57-47	61-99	40-46	3
12	Madhya Bharat	..	53-05	..	..	..	..	2-69	..	..	..	..	20-00	..	..
13	Mysore	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	Pepeu	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	Rajasthan	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	Saurashtra	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	Travancore-Cochin (Comp.)	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Travancore-Cochin (Alone)	..	..	..	..	..	..	1-54	1-53	0-96	1-18	0-7	78	1-04	..
"C" STATES															
18	Jammu and Kashmir	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	Ajmer	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	Bhopal	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	Bilaspur	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	Coorg	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	Delhi	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24	Himachal Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	Kutch	..	..	..	..	..	..	..	..	..	..	..	..	..	..
26	Manipur	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	Tripura	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	Vindhya Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[illegible]

TEMENT I



APPENDIX II—STATEMENT II

RIGATION IN INDIA (IRRIGABLE AREA IN LAKHS ACRES, CUMULATIVE)

[illegible]

Sl. No.	Name of State	Upto 1920	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32	32-33	33-34	34-35	35-36	36-37
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"A" STATES

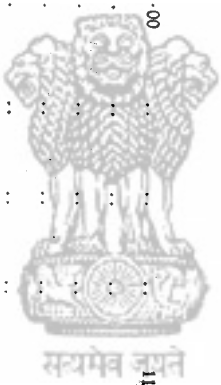
1	Andhra																		
2	Assam																		
3	Bihar																		
4	Bombay					0.43	0.59	0.65	0.75	0.87	0.99	1.11	1.23	1.35	1.47		1.59	1.81	
5	Madhya Pradesh																		
6	Madras																		
7	Orissa																		
8	Punjab																		
9	Uttar Pradesh																		
10	West Bengal					42.63					53.35	54.96	55.16	55.25	55.43				55.47

"B" STATES

11	Hyderabad							11.00					11.27	11.78	13.32	13.72	14.03	14.48	15.60	10.93
12	Madhya Bharat																			
13	Mysore																			
14	Pepsi																			
15	Rajasthan																			
16	Saurashtra																			
17	Travancore-Cochin																			

"C" STATES

18	Jammu and Kashmir																			
19	Ajmer																			
20	Bhopal																			
21	Bilaspur																			
22	Coorg																	0.04	0.043	0.046
23	Himachal Pradesh																			
24	Kutch																			
25	Delhi																			
26	Manipur																			
27	Triura																			
28	Vindhya Pradesh																			

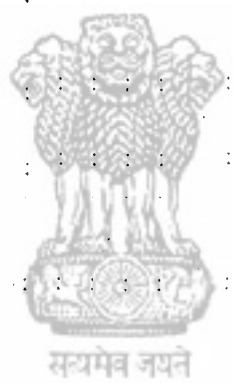


2.43
43.44
44.45
45.46
46.47
47.48
48.49
49.50
50.51
51.52
52.53
53.54
54.55
55.56
REMARKS

[illegible]

[illegible]

Sl. No.	Name of State	Upto 1920	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32	32-33	33-34	34-35	35-36	36-37	37.
"A" STATES																				
1	Andhra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	Assam	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	Bihar	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	Bombay	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	Madhya Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	Madras	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18-22	22-7	43-36	69-67	80-
7	Orissa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	Punjab	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	Uttar Pradesh	..	..	..	..	..	..	..	..	..	21-93	66-16	32-68	30-38	23-26	11-89	12-91	49-06	83-02	33
10	West Bengal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
"B" STATES																				
11	Hyderabad	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	Madhya Bharat	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13	Mysore	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	Pepsu	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	Rajasthan	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	Saurashtra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	Travancore-Cochin	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
"C" STATES																				
18	Jammu and Kashmir	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	Ajmer	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	Bhopal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	Bilaspur	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	Coorg	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	Delhi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24	Himachal Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	Kutch	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
26	Manipur	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	Tripura	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	Vindhya Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..



There is no F.

APPENDIX IV
LIST OF PROJECTS ANALYSED

Serial Number	Name of Project	Cost in Crores of Rs.	Scope	Gross Storage (x 1,000 Acre feet)	Area Irrigated (x 1,00,000 acres)	Power generated (installed capacity K. Watts.)	Remarks
1	2	3	4	5	6	7	8
1	Bhakra Nangal	158.8	Multipurpose project	7,400	70	1,86,000	The power potential for which the project has been designed is 9,96,000.
2	Damodar Valley (without Bokaro Thermal Station)	77.2	Ditto.	2,944	13.25	1,84,000	
3	Hirakud	70.8	Ditto.	6,600	6.72	1,23,000	
4	Tungabhadra	56.2	Ditto.	3,050	8.2	2,10,000	
5	Bhadra Reservoir	17.75	Ditto.	1,450	2.24	13,000	
6	Mayurakshi	16.1	Irrigation Project	500	6.5	4,000	(Mainly, an Irrigation Project).
7	Kakrapar	12.64	Ditto.	Nil.	6.5	Nil.	
8	Lower Bhavani	9.96	Ditto.	644	2.07	Nil.	

APPENDIX IV—Contd

1	2	3	4	5	6	7	8
9	Gatapabha	5.452	Ditto.	Nil.	1.02	Nil.	
10	Gangapur	3.97	Ditto.	166	0.451	Nil.	
11	Nugu Reservoir	2.4375	Ditto.	125	0.2	Nil.	
12	Tunga Anicut	2.3112	Ditto.	Nil.	0.215	Nil.	
13	Walayar Reservoir	0.9992	Ditto.	15.4	0.07	Nil.	
14	Koyna	31.16	Power Project	1020	..	2,40,000	
15	Machkund Hydel Project (Joint Scheme and Orissa part)	26.39	Ditto.	587	..	1,02,000	
16	Mahatma Gandhi Hydel Scheme	8.25	Ditto.	574	..	1,20,000	
17	Umtru Project	1.12	Ditto.	Nil.	..	5,000	

in the form supplied by the Hirakud, Tungbhadra and Bhadra Project Authorities relating to graduate engineers (Electrical), is of little use for obtaining a proper average. Analysis of the power projects that 18.5 man-years of graduate engineers (Electrical) are needed per crore of cost of electrical works. The cost of electrical works of Hirakud is Rs. 15 crores and Rs. 9 crores approximately. As such it has been assumed that the total number of man-years for graduate engineers (Electrical) for Hirakud would be 7.5 approximately and for Tungbhadra $9 \times 18.5 = 166.5$ approximately. Bhadra had been designed for a comparatively small amount of electrical power, and thus the purpose projects excluding Bhakra have been calculated as below:—

Total Number of man-years of Graduate Engineers (Electrical) for D. V. C. = 6.08×17.2	470
Total Number of man-years of Graduate Engineers (Electrical) for Hirakud = 18.5×15	277.5
Total Number of man-years of Graduate Engineers (Electrical) for Tungbhadra = 18.5×9	166.5
Total	915

Total cost of the above Projects = $78.2 + 70.8 + 56.2 = 205.2$.

and average man-years per crore for multipurpose projects other than Bhakra is $915/205.2 = 4.45$.

number of graduate engineers (Civil) in the case of Hirakud is low as the design-staff figures were not available and were therefore excluded. The figure has accordingly not been made use of while calculating the average. The same remarks apply to the Electrical Staff.

ure for graduate engineers (Electrical) for Bhadra is Nil, because upto 1954-55, little electrical work had been started.

ure for graduate engineers (Electrical) for Tungbhadra seems doubtful.

il and therefore not taken into account while calculating the average for Multipurpose Projects other than Bhakra.

not given because of (1), (2) and (3).

not given because of (4).

lthorally low and doubtful for D. V. C., the figure for Bhadra is low as the electrical works are comparatively small. While calculating the average man-years per Crore this category for Multipurpose Projects other than Bhakra only the figures for Hirakud and Tungbhadra have been taken into account.

for Umtru for graduate engineers (Electrical) and Overseer (Electrical) + Overseer (Mechanical) do not appear here because the electrical works had not sufficiently advanced at the time the data was collected.

ot given because of (8).

doubtful.

ot given as figure for Electrical Foremen is not available.

APPENDIX V

PER CRORE OF RUPEES OF COST (For Individual Projects)

	Power Projects				Remarks
	Koyana layer under Power Project Scheme Orissa (part)	Machkund Hydel (Joint Scheme Orissa part)	Mahatma Gandhi	Umrta Hydel Scheme	
1-0	31.2	26.4	8.25	1.12	
3-19	13.54	13.65	19.48	9.36	
3-97	0.87	3.62	..	..
..	3.34	6.01	11.69	—(8)	
4-16	17.75	23.28	31.2	.. (9)	
46-6	54	27.2	49.3	3.56(10)	
5-82	10	25.3	1.137	—(8)	
6-06	3.49	12.4	8.99	3.56	
8-5	67.5	64.9	59.4	(9)	
..	1.1	1.83	13.40	..	
available		5.12	4.55	5.35	While taking the averages for the group
available		1.75	5.63	..	Multipurpose projects other than Bhakra
available		3.1	8.1	1.78	Man-years per crore for Foremen have been calculated by averaging figures for Hirakud, Tungbhadra, Bhakra operators have been calculated by averaging figures for D.V.C., Hirakud and Tungbhadra and Mechanics have been calculated by averaging figures for D.V.C., Tungbhadra and Bhakra because of doubtful nature of figures marked (4).
N.A.	N.A.	9.97	18.28	7.13	
I.A.	N.A.	3.16	6.99	N.A.	
I.A.	N.A.	11.44	61.55	1.78	
I.A.	N.A.	14.6	68.54	1.78	
I.A.	2.0	10.03	5.16	1.78	

*The data, in the form supplied by the Hirakud, Tungbhadra and Bhakra Project Authorities relating to graduate engineers (Electrical), is of little use, on analysis of the power projects that 18.5 man-years of graduate engineers (Electrical) are needed per crore of cost of electrical works. The 15 × 18.5 = 277.5 approximately and for Tungbhadra 9 × 18.5 = 166.5 approximately. Bhakra had been designed for a comparatively small amount average for Multipurpose projects excluding Bhakra have been calculated as below:—

Total Number of man-years of Graduate Engineers (Electrical) for D. V. C. = 6.08×17.2 .

Total Number of man-years of Graduate Engineers (Electrical) for Hirakud = 18.5×15 .

Total Number of man-years of Graduate Engineers (Electrical) for Tungbhadra = 18.5×9 .

Total cost of the above Projects = $78.2 + 70.8 + 56.2 = 205.2$.

(1) The number of graduate engineers (Civil) in the case of Hirakud is low as the design-staff figures were not available and were therefore excluded from use of while calculating the average. The same remarks apply to the Electrical Staff.

(2) The figure for graduate engineers (Electrical) for Bhakra is Nil, because upto 1954-55, little electrical work had been started.

(3) The figure for graduate engineers (Electrical) for Tungbhadra seems doubtful.

(4) Doubtful and therefore not taken into account while calculating the average for Multipurpose Projects other than Bhakra.

(5) Totals not given because of (1), (2) and (3).

(6) Totals not given because of (4).

(7) Figure abnormally low and doubtful for D. V. C., the figure for Bhakra is low as the electrical works are comparatively small. While calculating for this category for Multipurpose Projects other than Bhakra only the figures for Hirakud and Tungbhadra have been taken into account.

(8) Figures for Umrta for graduate engineers (Electrical) and Overseer (Electrical) + Overseer (Mechanical) do not appear here because the electrical at the time the data was collected.

(9) Total not given because of (8).

(10) Figure doubtful.

(11) Total not given as figure for Electrical Foremen is not available.

MAN-YEARS PER CRORE OF

Category of Technical Personnel	Multipurpose Projects				Irrigation Projects										
	Bhakra Nangal	Damodar Valley Corporation (excluding Bokaro)	Hirakud	Tungbhadra	Bhadra	Mayurakshi	Kakrapar	Lower Bhavani	Gangaprabha	Gangapur	Nugu Reservoir	Tunga Anicut	Koyana Warliar Reservoir	Koyana under Power Project	
Cost of Projects in crores	158.8	77.2	70.8 (1)	56.2	17.75	16.1	12.64	9.96	5.45	3.97	2.44	2.31	1.0	31.2	2
Graduate Engineers (Civil)	14.3	15.16	6.96	12.89	14.0	20.48	11.36	13.22	16.04	17.32	17.21	30.35	3.19	13.54	13
Graduate Engineers (Mechanical)	2.95	2.62	2.37	1.67	2.1	2.9	2.36	1.03	1.5	4.84	..	..	0.97	0.87	3
Graduate Engineers (Electrical)	3.37	6.08	1.395 *(1)	0.85 *(3)	0.4 *(2)	0.4	..	0.688	..	1.49	..	..	..	3.34	6
Graduate Engineers Total	20.6	23.86	—	—	—	23.8	13.72	14.94	17.54	23.65	17.21	30.35	4.16	17.75	22
Overseers (Civil)	19.3	12.3	25.6	59.8	22.8	45.5	45.7	49.2	43	50.6	32.9	74.5	16.6	54	27
Overseers (Electrical) + Overseers (Mechanical)	10.09	2.09	8.95	10.03	2.16	8.41	11.3	5.08	08	15.67	..	..	5.82	10	25
Draftsmen	10.1	7.0	11.52	9.07	3.95	12.31	4.37	11.61	6.17	5.21	10.4	11.46	5.06	3.49	12
Overseers + Draftsmen	39.5	21.39	46.07	78.9	28.91	66.2	61.4	66.7	52.2	71.5	43.3	86.0	18.5	67.5	64
Sub-Overseers + Work-charged Surveyors etc.	4.94	7.5	8.33	2.83	32.4	6.9	0.25	..	18.1	72.5	79.2	57.3	..	1.1	1
Mechanical Foremen etc.	16.95	1.37(4)	6.66	9.1	4.57 (4)	1.85	2.5	3.735	1.21	36.96	3.47	Figures not available	..	..	5
Operators	58.2	31	34.6	38.9	12.0	14.4	29.85	38.9	42.65	53.37	9.84	Figures not available	..	..	1
Mechanics	11.25	6.83	11.91 (4)	14.67	11.34	2.18	13.4	14.96	8.93	Not reliable	4.05	Figures not available	..	..	1
Mechanical Foremen etc., + Operators + Mechanics	86.4	(6)	62.7	(6)	18.43	45.8	57.6	52.8	Not reliable	17.36	N.A.	N.A.	N.A.	N.A.	9
Electrical Foremen etc.	6.24	0.62	0.76	1.1	0.62	N.A.	0.25	.519	N.A.	2.94	..	N.A.	N.A.	N.A.	1
Electricians + Linemen + Wiremen	14.98	1.68	11.71	20.71	3.78	1.89	4.37	4.05	N.A.	21.3	..	5.73	N.A.	N.A.	11
Electrical Foremen, Chargemen, Line Inspectors, Electricians + Linemen and Wiremen	21.2	2.30(7)	12.47	21.8	4.4 (7)	1.89	4.62	4.57	N.A.	23.64	..	(11)	N.A.	N.A.	1
Accountants	3.41	6.54	3.23	3.52	3.15	5.26	N.A.	N.A.	2.86	N.A.	3.47	2.71	N.A.	2.0	10

APPENDIX VI—STATEMENT I
AVERAGE MAN-YEARS PER CRORE OF RUPEES OF COST OF CONSTRUCTION

Category of Personnel	Bhakra (Serial No. 1)	Multipur- pose (1) Projects other than Bhakra (Serial Nos. 2, 3, 4 & 5)	Irrigation Projects (Serial Nos. 6 to 13)			Power Projects (Serial Nos. 14 to 17)			Remarks
			Projects costing above Rs. 10 Crores	Projects costing below Rs. 10 Crores	Projects costing above Rs. 10 Crores	Projects costing below Rs. 10 Crores	Projects costing above Rs. 10 Crores	Projects costing below Rs. 10 Crores	
1	2	3	4	5	6	7	8		
Graduate Engineers (Civil)	14	14	17	17	14				
Graduate Engineers (Mechanical)	3-0	2-2	2-2	1-6	1-8	1-3			
Graduate Engineers (Electrical)	3-4	4-5	0-4			5-5			
Graduate Engineers (Total)	20-4	20-7	19-6	19-0	21-3	20-0			
Overseers and equivalent (Civil)	19	29	46	46	(45)				
Overseers and Equivalent (Electrical) + Overseers and Equivalent (Mechanical)	10	6-6	8-7	3-9	(14)				
Draftsmen.	10	9	9	7-5	(7-7)				
Overseers and Draftsmen	39	45	64	57	(67)				
Sub-overseers etc. (Civil)	4-94	8-5	15-3	(2-67)					
Mechanical	..	..	..	..	..	..
Foremen etc.	17-0	7-3	2-4	(5-0)					
Operators	58-2	34-4	26-9	(2-7)					

APPENDIX VI—STATEMENT I—Contd.

1	2	3	4	5	6	7	8
Mechanics	.	.	.	.	.	.	.
Mechanical Assistants (Foremen and Chargemen, Operators & Mechanics)	11.2	10.3	(8.7)	.	.	(4.2)	.
Electrical Assistants (Foremen, Chargemen, Line Inspector)	86.4	52.0	(38.0)	.	.	(11.9)	.
Accountants	6.2	1.3	(0.6)	.	.	(4.4)	.
	3.4	4.4	(4.4)	.	.	(5.5)	.

(1) All Multipurpose Projects for which data were available cost above Rs. 10 crores each.

NOTE.—(1) The Mechanical Staff is closely related to the degree of mechanisation. If the figures for mechanical staff of the two irrigation projects costing above Rs. 10 crores, namely Mayurakshi and Kakrapar, are averaged the results are lower than the average figures for projects costing below Rs. 10 crores, as Mayurakshi is less mechanised. Normally projects costing above Rs. 10 crores should be more mechanised than projects costing less than Rs. 10 crores. Hence average figures are given for the Irrigation Projects as a whole.

(2) For power projects the data available were meagre. Out of the four projects for which data were available, some data for Umtru could not be made use of as the Electrical works on the project had not advanced sufficiently at the time the data were collected. For Koyna also, no data were available regarding the operational and maintenance staff, during construction; moreover construction has only just begun. There may usually be no mechanical Executive Engineer employed on power projects costing below Rs. 10 crores and therefore only Graduate Engineers (Mechanical) have been given separately for projects above Rs. 10 crores and projects below Rs. 10 crores but for other items, an average for the power projects as a whole has been given.

(3) Wherever a bracket appears, the figure given below the bracket, applies equally to the projects above Rs. 10 crores and the projects below Rs. 10 crores.

APPENDIX VI—STATEMENT II
YARDSTICKS FOR MAINTENANCE OF PROJECTS
Strength required for crore rupees of Capital cost for
Groups of Projects

Serial num- ber	Category	Multipur- pose pro- jects	Irrigation Projects	Power Projects
1	2	3	4	5
1	Graduate Engineers Civil	0.42	0.86	0.19
2	Graduate Engineers Mechanical	0.0544	0.04	0.18
3	Graduate Engineers Electrical	0.21	..	1.24
4	Overseers and Draughtsmen Civil	1.4	2.3	0.92
5	Overseers (Mechanical and Electrical)	0.7	0.13	3.5
6	Sub-Overseer and Work-charged Surveyors (Civil)	1.8	1.8	0.5
7	Mechanical Assistants (Foremen, Chargemen, Operators and Mechanics)	1.2	1.1	4.0
8	Electrical Assistants (Foremen, Chargemen and Line Inspectors)	1.4	0.01	4.0
9	Accountants	0.16	0.16	0.39



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APPENDIX VII.—STATEMENT I
CENSUS ON 1-4-54 OF STAFF EMPLOYED ON CONSTRUCTION OF RIVER VALLEY PROJECT

TECHNICAL PERSONNEL

S. No.	STATE	Chief Engineer (Civil)	Chief Engineer (Electrical)	Superintending Engineer (Civil)	Superintending Engineer (Mechanical)	Superintending Engineer (Electrical)	Executive Engineer (Civil)	Executive Engineer (Mechanical)	Executive Engineer (Electrical)	Asstt. Engineer and equivalent (Civil)	Assistant Engineer and equivalent (Mechanical)	Asstt. Engineer and equivalent (Electrical)	Supervisor, Overseers and equivalent (Civil)	Supervisor, Overseers and equivalent (Elec.&Mech.)	Sub-Overseer (Civil)	Sub-Overseer (Elec. & Mech.)	Draftsman (all grades)	Storekeepers.	MECHANICAL	Foreman, Asstt. Foreman and Chargeman	Operators, crane-man, scraper, tractor, bulldozer, shovel, dragline and heavy transport.	Mechanics.	Fitters.	Engine Driver (Diesel & Petrol)	Engine Driver (Steam)	Driller.	Machinist.	Welder.	Sarang.	ELECTRICAL	Foreman, Asstt. Foreman, Chargeman, Line	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
1. Assam	1	1	2	2	2	2	6	1	3	91	11	4	441	60	29	31	16	13	316	69	239	37	20	15	14	8	2	2	2	2	2	
2. Bihar	1	1	1	1	1	1	2	1	3	92	6	21	343	88	825	2	2	35	254	90	13	22	26	15	10	10	2	2	2	2	2	
3. Bombay	1 1/2	1 1/2	4	4	2 1/2	2 1/2	20	1	3	91	11	4	441	60	29	31	16	13	316	69	239	37	20	15	14	8	2	2	2	2	2	
4. Madras	1	1	2	2	2	2	19	1	3	92	6	21	343	88	825	2	2	35	254	90	13	22	26	15	10	10	2	2	2	2	2	
5. Madhya Pradesh	1 1/2	1 1/2	4	4	2 1/2	2 1/2	20	1	3	91	11	4	441	60	29	31	16	13	316	69	239	37	20	15	14	8	2	2	2	2	2	2
6. Orissa	1	1	1	1	1	1	14	5	5	14	32	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
7. Punjab	3	2 1/2	12	12	7	65	14	29	218	59	75	748	223	4	107	101	506	921	285	160	175	108	70	158	2	124	124	124	124	124	124	
8. Uttar Pradesh	1	1	5	5	1	21	1	6	71	17	20	430	4	62	54	11	303	82	3	136	90	2	12	43	43	43	43	43	43	43	43	43
9. West Bengal	2	2	2	2	2	6	1	1	29	5	1	101	20	20	21	7	7	86	22	4	4	4	4	4	4	4	4	4	4	4	4	4
10 D.V.C.	1	1	9	2	6	33	3	19	170	40	75	227	66	97	13	468	99	51	123	7	27	85	10	10	10	10	10	10	10	10	10	10
11. Hira-kud	1	1	3	3	1	14	2	3	51	22	13	241	142	86	19	70	363	263	499	39	13	36	78	68	25	9	9	9	9	9	9	9
12. Tungbhadra	1	1	4	4	1	9	1	1	30	5	2	121	17	56	11	35	11	45	211	90	528	289	166	26	5	5	5	5	5	5	5	5
13. Mysore	1	1	1	1	1	825	5	5	39	28	127	132	127	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
14. Madhya Bharat	3/8	3/8	3/8	3/8	3/8	5	5	5	39	28	127	132	127	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
15. Chambal Projects	1	1	1	1	1	4	4	4	12	2	25	8	2	5	3	11	41	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
16. Rajasthan	1	1	1	1	1	5	5	5	16	2	69	2	69	2	5	3	11	41	13	13	13	13	13	13	13	13	13	13	13	13	13	13
17. Saurashtra	1	1	1	1	1	6	6	6	19	19	57	6	70	32	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
18. Himachal Pradesh	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
19. Travancore-Cochin	1	2	2	2	0.3	6	1.5	2.7	2.7	2.7	3	266	8	22	16	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
20. Vindhya Pradesh	1	1	1	1	1	2	2	2	13	3	39	8	3	198	61	364	29	58	5	3	14	6	40	1	2	2	2	2	2	2	2	2
21. Hyderabad	1	1	1	1	1	13	3	3	39	8	3	198	61	364	29	58	5	3	14	6	40	1	2	2	2	2	2	2	2	2	2	2
22. Andhra	1	1	1	1	1	12	3	2	3	39	8	3	198	61	364	29	58	5	3	14	6	40	1	2	2	2	2	2	2	2	2	2
23. Jammu and Kashmir	1	1	1	1	1	12	3	2	3	39	8	3	198	61	364	29	58	5	3	14	6	40	1	2	2	2	2	2	2	2	2	2
24. Meckund Joint Scheme	1	1	1	1	1	12	3	2	3	39	8	3	198	61	364	29	58	5	3	14	6	40	1	2	2	2	2	2	2	2	2	2
25. Pepsu	1	1	1	1	1	12	3	2	3	39	8	3	198	61	364	29	58	5	3	14	6	40	1	2	2	2	2	2	2	2	2	2

Sl.	STATE	TECHNICAL PERSONNEL																											
		Chief Engineer (Civil)	Chief Engineer (Elec.)	Supdt. Engineer (Civil)	Supdt. Engineer (Mech.)	Supdt. Engineer (Elec.)	Executive Engineer (Civil)	Executive Engineer (Mech.)	Executive Engineer (Elec.)	Assistant Engineer (Civil)	Assistant Engineer (Mech.)	Assistant Engineer (Elec.)	Supervisors (Civil)	Supervisors (Mech.)	Supervisors (Elec.)	Draftsman (all grades).	Store-keepers.	Research Assistant.	MECHANICAL Foreman charge-man.	Operators, crane, tractor, scraper, Bulldozer shovel and dragline.	Operators heavy duty transport.	Mechanics all categories	Engine Driver Diesel and petrol.	Engine Driver Steam.	Welders.	Fitters.	Machinist.	Sarang.	
1	West Bengal (Irrigation and Waterways)	1	..	3	..	..	18	..	65	..	..	..	303	..	..	35	1 N.A.	..	..	..	..	1	3 N.A.	..	..	..	..	2
2	Orissa (Irrigation and Flood Control)	1	..	2	..	..	7	..	21	2	..	83	..	..	28	1 N.A.	1	..	..	..	..	1	1 N.A.	..	..	15	..	6
3	Mysore (Running system)	1	1	1	1	4	2.5	1	5	16	1	16	22.5	13	38	12.5	5.5	N.A.	11	..	..	265	..	N.A.	..	..	..
4	Madras (Electricity)	1	1	4	..	..	8	..	34	..	..	315	..	..	19	12 N.A.	1	4	..	..	..	1	1 N.A.	3	..	24	..	4
5	Madras (Irrigation)	1	1	4	..	..	8	..	34	..	..	315	..	..	19	12 N.A.	1	4	..	..	..	1	1 N.A.	3	..	24	..	4
6	Madras (Irrigation Work shop)	1	1	4	..	..	19	1	71	3	..	230	46	92	..	N.A.	10	2	..	..	..	66	2 N.A.	13	25	29	2	..
7	Punjab	1	1	6	..	3 1/10	19	..	13	76	..	46	341	13	123	29	8	14	2	..	..	67	2 N.A.	5	25	29	2	..
8	Bombay	1	1	..	..	..	5	..	24	2	..	95	5	1	6	5	N.A.	..	32	..	..	1	..	N.A.	..	..	..	..
9	Madhya Bharat	1	1	3	..	..	9	1	33	3	..	134	8	..	16	10	N.A.	..	..	..	..	..	N.A.	..	9	4	..	..
10	Rajasthan	1	1	3	..	..	9	1	33	3	..	134	8	..	16	10	N.A.	..	..	..	..	..	N.A.	..	9	4	..	..
11	Kutch	..	..	..	..	..	1	..	3	..	..	13	..	..	5	1	N.A.	..	..	..	..	..	N.A.	..	..	..	..	..
12	P.W. D. Vindhya Pradesh	..	..	1	..	..	2	..	4	..	..	10	..	..	1	..	N.A.	..	..	..	..	..	N.A.	..	..	..	..	..
13	Madhya Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	Hyderabad (Irrigation Branch)	..	..	19/20	..	..	7	..	14	..	..	179	..	..	60	..	N.A.	..	..	..	..	..	N.A.	..	..	..	..	..
15	Saurashtra	..	..	..	..	..	..	..	..	..	..	3	..	..	4	..	N.A.	..	..	..	..	..	N.A.	..	..	..	..	..
16	Himachal Pradesh	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	N.A.	..	..	..	..	..
17	Andhra	1	1	4	..	..	27	1	104	11	..	355	60	212	7	N.A.	14	2	..	..	..	94	3 N.A.	19	36	41	3	..
18	Jammu and Kashmir	..	..	1	..	..	1	..	6	..	..	24	..	..	3	2	N.A.	1	2	..	..	2	..	N.A.	..	4	6	..
19	Travancore-Cochin	..	0.8	1.4	..	3	7.0	..	5.5	14	..	21	134	395	45	..	N.A.	2	..	..	26	4	N.A.	3	5	10	..	..
20	Assam	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	N.A.	..	..	..	..	..
21	Uttar Pradesh	2.1	1	6	..	..	34	..	116	4	2	571	..	..	17	11	N.A.	..	..	..	..	7	1	1	..	1	..	..
22	Pepsu	1	1	2	..	1	7	..	2/3	28	..	1	59	2	17 1/2	10	N.A.	2	N.A.	1
Total		11	4	42	..	18	183	6	5	663	35	157	3,017	929	776	115	N.A.	72	48	570	46	2	57	250	167	

STAFF EMPLOYED ON MAINTENANCE OF RIVER VALLEY PROJECTS.

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STATEMENT I

VER VALLEY PROJECTS FOR THE YEARS 1954-55 TO 1960-61

Recruitment for 56-57			Annual recruitment necessary in 57-58 and thereafter i.e. when the 'hump' is crossed					Average Annual recruitment in the years from 1957-58 to 1960-61
Assuming requirements fully met	Assuming requirements are only partially met	Numbers necessary with partial recruitment in 1954-55 & 55-56 in order to bring the strength in 56-57 to actual requirements as shown in Col. 4	(Hump in 1956-57 Col. 8c minus Col 8b)	1957-58	1958-59	1959-60	1960-61	
8(a)(t)	8(b)(u)	8(c)	9	10(w)	11(w)	12(w)	13(w)	14
463	178	1,509	1,331	139	209	174	205	194
99	38	161	123	28	36	29	44	34
226	87	247	160	80	98	65	116	90
788	303	1,917	1,614	297	343	268	365	318
1,971	579	4,631	4,052	716	856	767	848	797
802	212	1,207	995	277	337	269	401	321
2,773	791	5,838	5,047	993	1,193	1,036	1,249	1,118
435	401	802	401	342	372	277	339	332
1,050	944	1,888	944	818	994	752	959	880
389	250	499	249	280	324	267	382	313
196	172	344	172	72	79	16	82	74

x VII.

Appendix VI.

Committee. Reference Appendix VI.

per cent. for (B) 4 per cent. for (C), (D) & (E) 8 per cent. and for (F) 3 per cent. advised by the Committee—Reference Appendix VI and replacement rates shown

APPENDIX VIII—STATEMENT I

ALL INDIA RATES OF TECHNICAL PERSONNEL RECRUITMENT FOR RIVER VALLEY PROJECTS FOR THE YEAR 1957-58

S. Category of No. Personnel	Actual strength of construction and maintenance & Operation staff as on 1-4-54	Total requirements of construction and maintenance & Operation staff in 1956-57	Increase in requirements between 1-4-54 & 1956-57 (Col. 4 minus Col. 3)	Recruitment for 54-55			Recruitment for 55-56			Recruitment for 56-57			Annual recruitment 57-58 and thereafter	
				Assuming requirements are fully met	Assuming requirements are only partially met	Assuming requirements are fully met	Assuming requirements are only partially met	Assuming requirements are fully met	Assuming requirements are only partially met	Assuming requirements are fully met	Assuming requirements are only partially met	Numbers necessary with partial recruitment in 1954-55 & 55-56 in order to bring the strength in 56-57 to actual requirements as shown in Col. 4	(Hump in 1956-57 Col. 8c minus Col 8b)	1957-58 1958-59
1	2	3(r)	4(s)	5	6(a)(t)	6(b)(u)	7(a)(t)	7(b)(u)	8(a)(t)	8(b)(u)	8(c)	9	10(w)	
A	(1) Graduate Engineers (Civil)	2,254	3,871	1,617	907	141	491	177	463	178	1,509	1,331	139	
	(2) Ditto (Mech.)	270	476	206	69	35	68	36	99	38	161	123	28	
	(3) Ditto (Elec.)	555	925	370	140	76	63	103	226	87	247	160	80	
Graduate Engineers (Total)		3,079	5,272	2,193	1,116	252	622	316	788	303	1,917	1,614	297	
B	(4) Overseers & Equivalent (Civil)	8,661	13,197	4,536	1,724	391	1,774	565	1,971	579	4,631	4,052	716	
	(5) Overseers & equivalent (Mech. and Electrical)	1,754	3,097	1,343	431	139	361	219	802	212	1,207	995	277	
Overseers and equivalent (Total)		10,415	16,294	5,879	2,155	530	2,135	784	2,773	791	5,838	5,047	993	
C. Sub-overseers, work-charged Surveyors etc. (Civil)		998	2,151	1,153	487	244	572	898	435	401	802	401	342	
D. Mechanical Assistants, (Foremen, Chargemen, Operators & Diesel and Petrol Mechanics etc.)		5,780	8,115	2,335	1,376	938	1,052	1,012	1,050	944	1,888	944	818	
E. Electrical Assistants (Foremen, Chargemen, Line Inspector etc.)		784	1,323	539	245	122	127	120	389	250	499	249	280	
F. Accountants		756	1,245	489	139	69	235	151	196	172	344	172	72	

NOTES.—(r) Col. 3—based on the actual census carried out by the Committee—reference Appendix VII.

(s) Col. 4—Requirements based on the yard-sticks devised by the Committee—Reference Appendix VI.

(t) Col. 6a, 7a and 8a—Requirements based for each year on the yard-sticks devised by the Committee. Reference Appendix VI.

**Replacement rate to allow for retirement, drift etc. is assumed to be as below : for (A) 3 per cent. for (B) 4 per cent. for (C), (D) & (E) 8 per cent.

(w) Cols. 10 to 13—Computed on the basis of yard-sticks for maintenance and operation devised by the Committee—Reference Appendix VI & the foot note (**) above.

APPENDIX VIII—STATEMENT II
**ADDITIONAL REQUIREMENTS OF TECHNICAL PERSONNEL FOR
 THIRD AND FOURTH PLANS**

Serial Num- ber	Category of Personnel	Additional requirements during	
		Third Plan	Fourth Plan
1	2	3	4
A	1 Graduate Engineers (Civil)	2,600	2,400
	2 Graduate Engineers (Mechanical)	350	380
	3 Graduate Engineers (Electrical)	1,275	1,350
B	4 Overseers and Equivalent (Civil)	10,000	9,600
	5 Overseers and Equivalent (Mechanical and Electrical)	3,970	4,400
C	Sub-Overseers, work-charged Surveyors etc. (Civil)	3,650	4,000
D	Mechanical Assistant (Foremen, Chargemen, Operators and Diesel and Petrol Mechanics etc.)	8,500	9,800
E	Electrical Assistants (Foremen, Chargemen, Line Inspector etc.)	3,950	5,000
F	Accountants	1,000	1,000



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